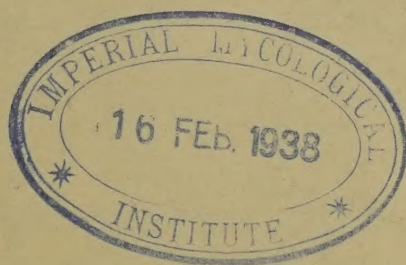


EMPIRE COTTON GROWING CORPORATION



PROGRESS REPORTS FROM
EXPERIMENT STATIONS
SEASON 1936-1937

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LONDON
1938

**PROGRESS REPORTS FROM EXPERIMENT
STATIONS, SEASON 1936-1937.**

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QUEENSLAND

COTTON RESEARCH STATION, BILOELA.

PROGRESS REPORT FOR THE SEASON 1936-37.

BY

L. M. HODGE (Manager), and W. A. R. COWDRY (Field Assistant).

SEASONAL AND GENERAL.

Climatic conditions during the past season were most unfavourable for the production of cotton. Planting was delayed beyond the optimum date and the growing period was comparatively short owing largely to the partial failure of the rains until December. The total rainfall for the period June-May was 22.55 inches, which is considerably below the average for the past thirteen years (28.73 inches). Moreover its distribution was most erratic, this factor alone exerting a great influence on the yields obtained.

The previous winter rains were of such a light nature that no residual effect remained in Spring. Dry conditions extended through September, but on the 5th October, 100 points were recorded which, though sufficient to permit the completion of ploughing, was not enough for planting with no succeeding rains in sight. The cultivated fallows were again relatively dry at the end of the month.

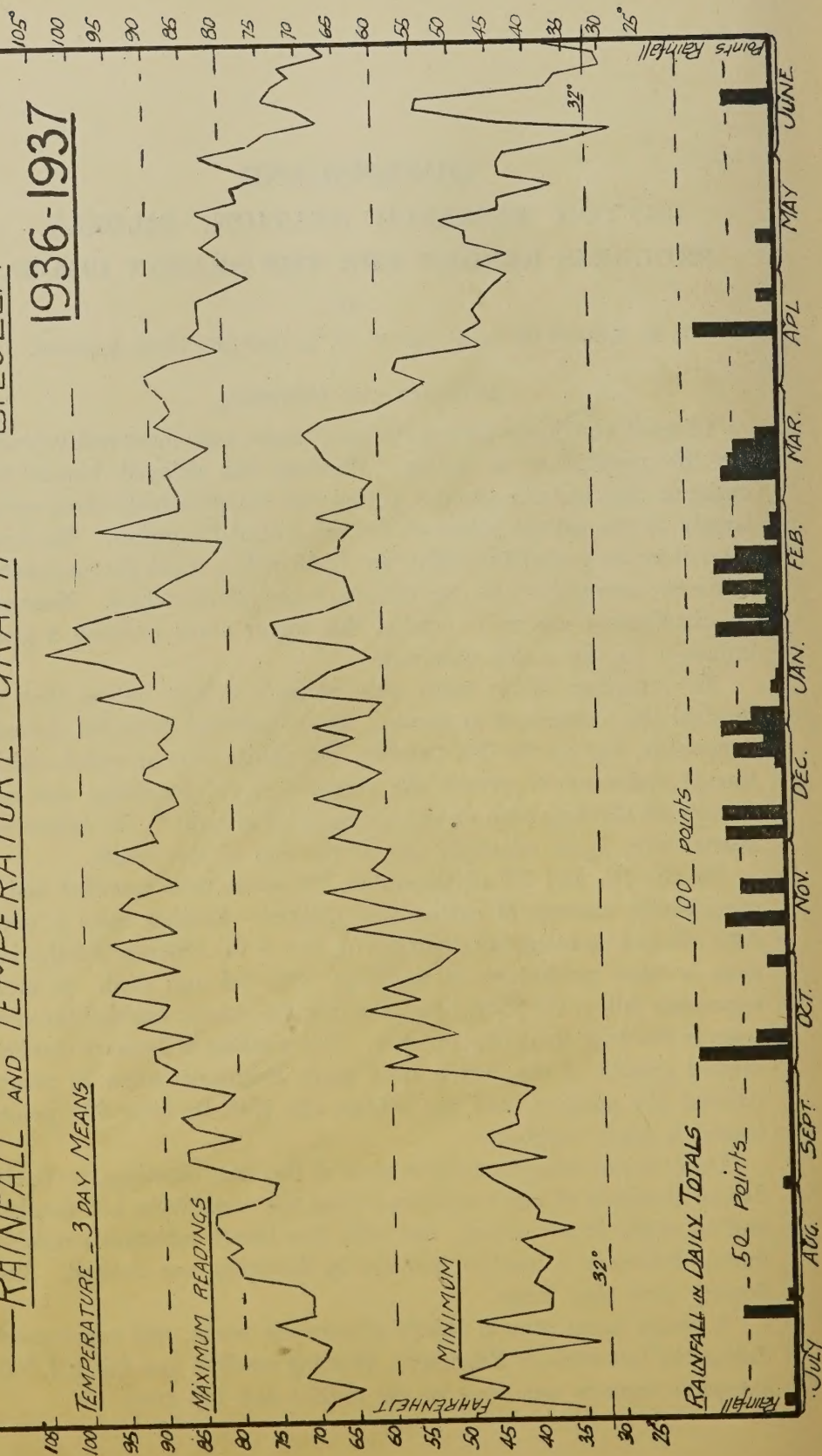
On the 4th and 5th of December, 70 points were recorded and a considerable amount of cotton was planted. Further rains a week later allowed planting to be completed, but in the absence of following rains a large percentage of seedlings withered and died. A most opportune fall on the 24th, besides saving the stands, enabled the seed sown in the drier areas to germinate. Dry weather in January checked further growth of the cotton until early February, when 75 points relieved the position, and again from the 10th to 14th, 274 points caused a ready response.

Delay in flowering occurred in most of the later plantings, probably due to shedding of small squares during the excessively hot weather and to slight insect attack, but with the better moisture available during February a marked increase in flowering was noticed. The flowers were also larger.

A severe insect attack, chiefly of corn ear worm, was experienced during the last week of February. Dusting resulted in a fair kill, but extensive damage was done to the middle and top crop.

BILLOELA

1936-1937



Rain received on the 17th caused a general burst of square formation, but the residual effect of the depredations of the corn ear worm, coupled with the dry conditions, caused all these to shed, and by the 5th April shedding was general. Fairly general opening of the more advanced bolls commenced by mid-April, especially on the newly broken up Rhodes grass land, but on areas of higher nitrate content a great mass of leaf obscured the bolls and delayed opening.

Dry weather during April and May caused immature opening to predominate in the more droughty areas. Picking was commenced on the 29th April, but the general pick did not start until late May. Frosts from the 2nd June onwards were severe and definitely closed the season at the Station.

Two pickings totalled 9,789 lbs. or an average of 187.1 lbs. per acre from 52.3 acres at the Station, which serves to show the difficulties of the season.

SEASONAL OPERATIONS.

The work at the Station has again consisted mostly of a continuation or amplification of investigations described in the previous reports, and includes soil moisture and nitrate studies, varietal testing, plant spacing, rotational cropping and pasture rotation. The lateness of the planting, considered in conjunction with lack of suitable rains, and heat waves, has done much to affect the results of some of these experiments.

Soil Moisture and Nitrate Determinations.—Throughout the season commencing on the 9th December, in conjunction with the grassland rotational and spacing test, soil moisture and initial nitrate determinations were taken each fortnight following the planting rains. The results of the first sampling closely followed expectations, showing that the borders following Rhodes grass had an average of 16.7% moisture as against an average of 13.1% in the borders following cotton, due to the residual effect of the grass making the soil more open in texture and allowing a better rainfall penetration.

The first nitrate determinations showed the soil following Rhodes grass to have an average of 5.2 parts per million as against an average of 16.6 in land following cotton. The seasonal rainfall was erratic throughout, so much so that at no time in the season did the moisture percentage remain above 20% for more than one determination. From the 17th February to the 3rd March the moisture percentage following Rhodes grass fell from 22.2% to 16.1% and following cotton from 21.0% to 15.6%. Again, whilst a sampling taken on the 13th March showed the Rhodes grass borders at 13.8% and the cotton borders at 12.9%, soil moistures taken following a fall of 396 points of rain

from March 13th to 17th showed that the percentages fell from 26.1% following grass and 25.5% following cotton to 18.4% and 16.1% respectively on the 31st March. This dry up caused the soil to pack very firmly, but still the Rhodes grass borders possessed a more open texture than did the cotton borders.

A study of the nitrate determinations reveals the difference between the two treatments from the beginning of the season when it was at an average of 11.4 p.p.m. to December and throughout the period until frost killed the plants. The nitrate content showed an average value of 3.8 p.p.m. following Rhodes grass as compared with 14.6 p.p.m. following cotton land. A noticeable feature of the effect of the reduction in nitrate content of the Rhodes grass borders was the excellent type of plant produced over the whole area. The foliage was smaller and slightly yellow tinged with reddish stems. The plants also fruited much earlier.

Varietal Tests.—The season under review saw a continuance of the varietal test of five varieties on different ages of cultivation, which is now in its fourth year of repetition. From the second year onwards a virgin cultivation is added so that in the season under review these varieties were under test on cultivations two, five, eight and twelve years old.

Germination was more rapid on the second-year-old land than on any other type, the twelve-year-old being the slowest. This differs from last season's results, but the difference is probably accounted for by the slow process of nitrate manufacture in the old cultivations under dry conditions.

The counts of fruiting nodes and shedding showed that the Miller variety inclined towards a more vegetative habit and shed to a greater extent, while Durango and Starvale appeared the best, for besides having the smallest shedding percentage, they possessed the greatest number of bolls and remaining forms.

Comparing the flower count figures obtained from each soil type, the most striking feature was the enormous increase in flowering made by the newest cultivation over all ages, which really reflects the better growing conditions. Another peculiar feature illustrated was the peculiar rise in flowering on the oldest cultivation during the latter half of March, which may have been due to a forced development by the dry weather at the end of February and early March.

Owing to the very poor yields, it was only possible to secure a bulk picking, which, while being necessarily low, was nevertheless indicative of the conditions which obtained in the several ages of cultivation during the season. The crop in the eight-year-old cultivation was so

poor that pickers refused to pick it, so that from a commercial standpoint its yield was nil, otherwise as the age of cultivation became less, the yields became progressively larger, as follows:—

58.5 lbs. per acre	—	12-year-old cultivation.
Nil	—	8-year-old cultivation.
146.5 lbs.	„	5-year-old cultivation.
424.2 lbs.	„	2-year-old cultivation.

The usual root measurements were taken in order that a continuous record might be available for the five years under which the test is to be conducted, showing the relative influence that each age of cultivation has upon the size and structure of the roots of each variety. The harder, finer particled, lighter soils of the older cultivations appeared to retard the development of fibrous lateral roots and progression towards the new country shows an increase in size. No significant differences were obtained in regard to varietal characteristics.

Sieving tests were also carried out on the twelve-year-old cultivation and two-year-old cultivation and as usual the older country contained more of the larger clods and lumps. The new cultivation possessed a more granular structure than the old one, there being no significant difference between the finest fractions, but definitely significant differences in the coarser grades.

Spacing Tests.—This spacing test was carried out as in previous years, but the Miller variety was substituted for Indio Acala, owing to its greater commercial value. The area was a two-year-old cotton cultivation and the spacings were unthinned, one foot bunches, two foot bunches, two foot doubles, one foot singles and two foot singles.

A fair commercial strike was obtained by mid-January. The unthinned plots were the tallest with the least branching, and all the closer spacings showed the effect of the several heat waves, while the flowering of the wider spacings was better per row than that of the more closely spaced plants. These results are a repetition of those obtained previously and suggest that moisture was the limiting factor in growth. They also indicate that a greater margin of safety is obtained by thinning to single plants at least one foot apart, although no significant differences in yield were obtained between any two spacings.

Spacings of unthinned, one foot, and two feet were carried out to compare these spacings on land where cotton has been grown continuously and where cotton followed three years Rhodes grass. Moisture samplings taken immediately after planting and a fortnight later showed that the Rhodes grass areas were better supplied with

moisture. A count made late in December showed that the Rhodes grass areas had lost 12.66% seedlings while the cotton-cotton areas suffered a loss of 23.03% burnt off during the hot weather. Plant populations and terminal loss counts made at the end of January shewed that Rhodes grass areas produced much the better stand. As far as terminal loss was concerned the cotton-cotton areas had suffered only slightly more damage. A nice type of plant was produced over the whole of the experiment, but it was evident that the Rhodes grass areas were drawing on a soil which was poor in nitrate. As a result, the plants showed a yellowish tinge, with reddened stems and smaller leaves. Fruiting was much earlier, although no difference in height was apparent, the extra moisture available from the Rhodes grass areas being sufficient to allow the plants to keep pace with the soils richer in nitrates, until the latter end of the season when the plants following cotton forged ahead.

The comparative growth of the unthinned plants and those spaced wider apart appears to be decided by the availability of water, for while all spacings were approximately the same early in the season, the wider spacings ultimately grew better than the unthinned which were the smallest of all eventually. Daily flower counts also bear this out. The closer spacings flowered remarkably well during the early stages, but lessened later.

The counts of fruiting nodes and shedding in a comparison between Rhodes grass and cotton contributed corroborative evidence of past results.

Roots from both areas were examined and it was found that a larger rooting system was made following Rhodes grass, rather in diameter of laterals than in number, the number of fibrous roots being practically the same. When analysed statistically the only significant difference obtained was in the size of laterals.

The resultant yields showed that crops following Rhodes grass out-yielded the cotton-cotton areas.

Considering each treatment as a separate unit, and analysing the data as two separate 3×5 randomized blocks, there was no significant difference between the wider spacings in either soil treatment. The unthinned plots, however, yielded significantly better than the other spacings when following Rhodes grass, but after continuous cultivation its yield was significantly lower. The analysis of variance bore out the above statement, and demonstrated the following points:—when considering each of the spacings separately the difference in yield between the Rhodes grass and cotton treatments was significant, the largest difference being when there had been no thinning, the

difference becoming smaller as the distance between plants increased until it was very little above the level of significance when the plants were spaced two feet apart.

Rotations.—The usual programme of crop rotations as outlined in previous reports was again carried out, cotton being rotated with the following crops :—

Sudan grass, maize, saccaline sorghum, giant setaria. There was a slight gain of 57 lbs. per acre where cotton followed a fodder crop, which is in agreement with past experience, a slight gain being made whenever a dry season is encountered.

The Rhodes grass-cotton rotation experiment was laid down to test the effect of following Rhodes grass with cotton and vice versa. Commencing with the season 1938-39 there will be seven treatments each year—first, second, and third year following Rhodes grass, cotton continuously, first second and third year Rhodes grass after three years' cotton.

This experiment has been planned on the result of observations over several years in which heavier crops of cotton have been produced on newly broken up grassland than were subsequently produced upon the same fields under cultivation. Soil analysis for initial nitrate determinations showed in parts per million, grass uncultivated—nil ; one year cultivation—13·5 ; old cultivation 30·6. It is thought that, as the available nitrates in grassland, as shown by analysis appear to be practically non-existent, the grass utilises this as it is formed, and that a two or three years' rotation of grass with cotton would probably reduce the excess of nitrates in the old cultivations and that this rotation would suit the economics of the district where dairying is carried on in conjunction with cotton-growing.

Combined fertiliser and grassland effect experiment.—In this experiment a complete fertiliser was used to test the possibility of the Rhodes grass having reduced the nutrients in the soil below fruiting cotton requirements. The experiment consisted of six half-acre blocks, three of which had been under Rhodes grass for three years and three similar blocks continuously cropped to cotton.

Moisture and nitrate determinations were taken nearly a fortnight after planting, and gave the following data :—

SOIL MOISTURE DETERMINATIONS.					6" level.	12" level.	Mean.
Following Rhodes Grass	...	...	...	...	15·2%	16·8%	16%
Following Cotton	...	...	...	...	13·7%	15·9%	14·8%
NITRATE DETERMINATIONS.					6" level.	12" level.	Mean.
Following Rhodes Grass	...	...	...	...	7·0 p.p.m.	3·4 p.p.m.	5·2 p.p.m.
Following Cotton	...	...	...	...	29·5 "	24·4 "	26·9 "

Seedling counts showed that better growing conditions were obtained in the Rhodes grass portions, for only 4·24% loss occurred as against a 17·23% loss following cotton.

Each half row was picked separately, thus giving the most detailed results obtainable. The Rhodes grass areas definitely outyielded those following three years of cotton in both pickings. In analysing the treatments separately, the differences between the yields following Rhodes grass and cotton are highly significant, but in no case is the effect of the fertiliser significant nor is the interaction between treatments significant.

SOUTH AFRICA

COTTON EXPERIMENT STATION, BARBERTON.

PROGRESS REPORT FOR THE SEASON 1936-37.

COTTON-BREEDING AND FIELD EXPERIMENTS.

BY

D. MACDONALD AND W. L. FIELDING.

Season and General.—The total rainfall for the year ending June, 1937, amounted to 40·59 inches, being 17·67 inches higher than the mean of the previous 11 years. The rains broke in mid-September, a fall of 1·72 inches enabling all winter-ploughed land on the Station to be worked down to a good seed bed. Following further good falls in mid-October all the main variety trials on the granite portion of the Station and all the multiplication bulks on the main Station were planted on 19th to 20th October. It was felt at the time that planting as early as this might be a risky proceeding, but with continuous good rains throughout the season the early planted cotton finished up with the highest yield of lint per acre obtained on the Station.

The bulk of the crop was got in during 31st October to 2nd November, under very good moisture conditions, full stands being obtained in all trials. Very heavy rains during the first and second week of November held up planting for a time but all the cotton was planted by November 17th.

At no period during the season did the crop suffer from drought, the main difficulty experienced being to keep down weed growth within the crop. During January and February 19·96 inches of rain fell, yet none of the re-selections showed any sign of shedding under what were practically water-logged conditions.

The rains finished on April 8th, but until mid-June temperatures remained high, enabling the crop to ripen and finish very well, apart from certain blocks which were badly damaged by *Alternaria* disease. The premature leaf-fall caused by *Alternaria* has never previously been a factor seriously affecting cotton yields either on the Station or in the district generally. The disease normally appears too late in the season to have much effect on the final yield and is chiefly associated with very early strains that have matured their crop, or with cotton growing on poor patches of soil. Reference was made to *Alternaria* in the Barberton section of Reports from Experiment Stations, 1928-29, page 36, and selections were made

Yes
RAM VII
P 306

with a view to following up any possible differences in susceptibility. During the ensuing seasons, however, the disease did not appear to any extent in the breeding plots and no progress was made in determining hereditary differences in resistance. Susceptibility is closely related to senescence of the plant and any factor that improves the general health of the plant late in the season, such as a dressing of kraal manure, a fallow in the previous season, etc., markedly reduces the amount of the disease.

In the present season the attack commenced early in March, much earlier than usual, and spread rapidly throughout the two Southern blocks of the Station, while the Northern blocks remained free from attack. The actual damage done was considerable and the final yield of the Southern blocks was about 150 to 220 lbs. lint per acre as against about 400 lbs. from the Northern blocks that were not attacked.

If the disease occurs again a further search will be made for any evidence of hereditary resistance. We know, however, that any factor which seriously impairs the general health of the plant renders it more liable to damage by the disease, and it is likely that the best method of control will be by improving the general health of the plant.

Climatic conditions similar to those on the Station were experienced throughout the Barberton area and several very high yields of cotton were obtained. Average yields from three farms on the Eastern side of the valley ranged from 860 to over 1,000 lbs. seed cotton per acre on 100-acre blocks, while on old tobacco land yields as high as 1,600 lbs. seed cotton were obtained on 20-acre blocks.

Damage by American bollworm on the Station was light except on a few fields of early planted bulks, good rains enabling an excellent crop to be produced later in the season. In the valley heavy damage was confined to individual farms but again a good recovery was made after the attack had passed.

Stainer damage was extremely light, considering the very wet conditions, and was confined to areas where ratoon cotton was grown in close proximity to plant cotton.

Jassid damage was very light and only affected the St. Vincent lots and other susceptible strains like Bancroft.

No damage due to aphid was recorded throughout the season. Mention was made in last season's Report of the association of aphid and a species of black ant *Myrmecaria natalensis* Sm., var. *obscuriceps* Sants. An effective control for the above species was found to be a solution of 1 oz. of sodium cyanide in 1 gallon of water. By filling the nests with the above solution, workers, larvae and queen were destroyed.

Selections.—As mentioned in last year's Report, a larger number of strains than usual had to be carried forward for future trial, on account of bacterial boll disease rendering accurate laboratory analysis of single plants very difficult. The major part of the area under single plant selections gave very good growth, while conditions for selection work were excellent throughout the season. The previous five seasons were on the whole very short ones with a bad drought occurring during mid-season. Under these conditions, the early strains always showed up to advantage over the later maturing lots. The later maturing strains had to be carried on as it was felt that, under better moisture and longer growing conditions, the position might be reversed in favour of the late strains. To a certain extent this has been proved true, some of the very late strains doing better in the past season than the very early lots. On the other hand, other families of late strains have shown up in an unfavourable light in both long and short seasons and can now be discarded with confidence.

It was stated in previous reports that the chief weakness of 052, the strain in general cultivation, was that its average ginning percentage is lower than most of the early strains. Re-selections from it made during the past two seasons have shown that the ginning percentage is capable of being raised considerably without loss of desirable characters. Two re-selections, which have shown up best in variety trials and observation plots, are being multiplied during the coming season with a view to replacing 052 in general cultivation.

The (U.4×Cambodia)×U.4 strains have now been reduced to twelve lots. They all resemble the U.4 parent in habit, growth and fruiting more than the Cambodia parent, but in earliness they are intermediate between the two. They do not appear to fruit as well as the best U.4 selections, while the jassid resistance appears to be about the same as the good U.4 lots. In the coming season they will be tested in variety trials along with good U.4 strains, in order to obtain an accurate estimate of their fruiting capabilities before doing any single-plant selection work on them. The original two U.4 parents sent to Dr. Harland to be crossed with Cambodia have long since been discarded in favour of better U.4 types, and it is proposed to use the best of our present U.4 strains to cross with good Cambodia plants during the coming season.

109 lots of "Red U.4" and (Asiatic×New World)×New World crosses sent from the St. Vincent Station were planted last season alongside the U.4 selection 052, for comparison. Germination in many of the strains was very bad, while fruiting in all the strains was poor compared with 052. The very light attack of jassid during the

season was sufficient to wipe out all the strains. It was noted that all the lots marked by Evelyn as being homozygous for red stem showed marked jassid susceptibility before the other lots. A "node of first flowering" count was made on sample plants from all the strains to get an idea of the range of earliness. This gave the average node of first flowering as ranging from 6 to 8, while the adjacent 052 had an average node of first flowering of 7.

Seven Malwa Upland strains received from Indore were tested, along with three lots from Lyallpur. All the strains from Indore grew well, being much more vegetative and leafy than the ordinary U.4 strains alongside. Fruiting was very poor and all were very late. The Lyallpur strains produced tall lax plants with extremely poor fruiting. Jassid was not present in sufficient numbers to have any effect even on one of the Lyallpur strains which had been marked as susceptible to jassid under Indian conditions.

Jassid Trials.—During the past few seasons the incidence of jassid has been so light that it was difficult to tell whether jassid resistance was being maintained in the later U.4 selections. Accordingly the main U.4 strains were planted on a randomized block experiment, each U.4 plot alternating with a plot of Rustenburg Bancroft, a strain very susceptible to jassid, in order to breed up jassid throughout the trial and get an estimate of the comparative resistance of the different U.4 strains. The remaining strains of the $(U.4 \times \text{Cambodia}) \times U.4$ crosses were treated in the same way along with two U.4 strains, in order to get a comparison of both the jassid resistance between U.4 strains and the crosses, and also the differences in resistance, if any, between the individual crosses.

Jassid counts in both trials were started in mid-January when the U.4 strains gave an average of 17 jassid nymphs per 48 plants, while Bancroft gave an average of 80 for a similar number of plants. From past experience a wet season favours the rapid multiplication of jassid, but this did not happen during the last season as later counts showed a decrease in the number of nymphs per plant. Possibly the torrential rains of January-February, amounting to 14 inches in 15 days, had an adverse effect on the rapid breeding up of jassid. Counts on $(U.4 \times \text{Cambodia}) \times U.4$ strains gave a figure for the jassid nymphs per plant similar to that for the U.4 strains. These trials will be repeated during the coming season.

Variety Trials.—Stands and growth in all variety trials on both loam and granite soil were excellent, a very large crop being set by the end of February. The final yields of the trials on the loam soil were very considerably lowered by an attack of *Alternaria* discussed earlier in this report.

As previously suspected, the long growing-season and good moisture conditions favoured some of the late strains, particularly 920 and a re-selection from it, 0268. This latter strain gave the highest yield of lint per acre in the main trial on both loam and granite soil. Very early strains, like 929R, gave significantly lower yields than the 920 re-selection and also appeared to be more susceptible to *Alternaria* than the more robust strains of both early and late varieties. On the other hand some late strains, chiefly derivatives of the 9264 family, showed up very badly and can now be discarded as doing poorly in both long and short seasons.

In a trial of early strains 052 again did well, giving the highest yield of lint per acre in the test. A number of re-selections from 052 and a sister strain 045 had reached the stage at which sufficient seed was available for incorporating them in a variety trial along with 052 and a later-maturing strain 096. This trial was damaged by *Alternaria* but in spite of this two of the 052 re-selections, 5143 and 5149, gave a higher yield of lint per acre than any other strain in the various trials on the loam soil. Both strains gave significantly higher yields than any other strain in the trial. The actual yields in lint per acre were 5143, 219 lbs.; 5149, 216 lbs.; 052, 173 lbs.; 096, 167 lbs. Difference required at $P = .05 = 21.5$ lbs. In addition to yielding well, the ginning percentage of both 5143 and 5149 is much higher than the parent 052. The actual figures from samples of the main pickings of the above trial are:—

<i>Strain.</i>	<i>Ginning percentage.</i>	<i>Seed weight.</i>
5143	36.5	8.8
5149	37.3	8.7
052	35.4	8.6

The trial of the main parent strains on the granite soil again gave excellent yields. This trial was planted on October 19th and received a top dressing of 150 lbs. per acre of nitrate of soda, after thinning. The final yields ranged from 406 to 501 lbs. lint per acre, the top yield being from strain 0268, while the lowest yields were from strains 046 and 929. These latter two strains also gave the lowest yield in a trial of the same strains on the loam soil.

Fertiliser Trial.—The lay-out of the fertiliser trial on the granite soil was altered during the past season. In the original lay-out the treatments were:—(1) superphosphate 250 lbs. per acre, (2) potash 200 lbs. per acre, both ploughed in before planting, (3) nitrate of soda 200 lbs., applied as a top dressing and hoed in after the cotton was thinned, (4) nil. As the Nil plots always gave the lowest yield

these plots were converted to plots receiving 250 lbs. superphosphate + 200 lbs. nitrate of soda.

The trial was planted on 19th October and plant samples were taken on 19th November, when differences in green weights from different treatments were found to be insignificant. Nitrate of soda was applied on 25th November and further plant samples were taken on 7th December. From the samples the green weights from the N, P and PN treatments were all significantly heavier than the green weights from the K. plots at $P = .01$. Further samples taken on 21st December showed no significant difference between green weights from different treatments. The final yield figures clearly demonstrate the beneficial effect of nitrate on light granite soil.

<i>Treatment.</i>	<i>Yields in lbs. seed cotton per acre.</i>
N.	1611
PN.	1472
P.	1331
K.	1252

Difference required for significance ($P = .05$) = 190 lbs.

Uniformity Trials.—During the past two seasons fields of 052 cotton have been used as uniformity trials in order to attempt to find out the best size and shape of plots and blocks to be used in variety trials. In the season 1935–36 the two fields used gave very uneven and poor growth, the final yields averaging only 363 and 430 lbs. seed-cotton per acre respectively. In season 1936–37 the field used produced very good growth and finally yielded an average of 1,117 lbs. seed-cotton per acre. Analysis of results from both seasons goes to show that long narrow plots are much more efficient than short wide plots. Doubling the length of row nearly halves the number of repetitions necessary to give a standard error of any given magnitude. The results of the past two years' work on uniformity trials are being prepared for publication in the near future.

Varying number of seeds per hill.—On the Station, the normal practice in planting all trials, where ample seed is available, is to plant three acid-treated seeds per hill. It had been noticed, however, that where a large number of seeds had been planted by mistake the seedlings on germination appeared to grow and develop more rapidly than where only three seeds had been planted and possibly only two seeds had germinated. Normally, development of the cotton plant in the early stages on the loam soil on the Station is very slow and it is important to find out if, by increasing the seed rate, early growth can be speeded up, thereby lessening the damage to which

the plant is liable when small, and also to find out if the final yield of lint per acre can be increased. In order to determine the optimum number of seeds per hill which should be planted the experiment was designed as follows. Four treatments using 2, 3, 6 and 10 seeds per hill were laid out in randomized blocks using two-row plots 90' long. Of the 90' length, 30' of plots were used for final yield figures, while the remaining 60' were used for sampling and development studies on three different times of thinning throughout the season.

The results go to show that three seeds per hill appears to be the best seed-rate for conditions prevailing during the last season. As last season was one of abnormally heavy rainfall the experiment will be repeated and a full report of the experiment written up in due course.

Compost.—During the past season the waste products of the Station have been successfully composted by a modification of the Indore process. Experiments using different dressings per acre of the compost made have been laid down on both loam and granite soils for cotton trials during the coming season. During the present winter several pits have been charged, each pit having a different composition, in order to attempt to find out what are the essential minimum amounts of the different constituents used to ensure rapid and satisfactory breaking down of waste material.

BARBERTON.

DAILY RAINFALL IN INCHES, SEASON 1936-37.

<i>Date</i>	<i>July</i>	<i>Aug.</i>	<i>Sept.</i>	<i>Oct.</i>	<i>Nov.</i>	<i>Dec.</i>	<i>Jan.</i>	<i>Feb.</i>	<i>Mar.</i>	<i>April.</i>
1 ...	—	—	—	—	—	—	—	—	0.04	—
2 ...	0.08	—	—	0.56	—	—	0.12	—	—	—
3 ...	0.10	—	—	—	—	—	0.46	—	—	—
4 ...	—	—	—	—	—	0.03	0.76	1.47	—	0.04
5 ...	—	—	0.05	—	0.19	0.01	0.41	0.77	1.11	1.11
6 ...	—	—	—	—	0.08	—	0.15	1.09	0.03	1.22
7 ...	—	—	—	—	0.17	—	0.35	1.17	—	0.01
8 ...	—	—	—	—	0.13	0.36	0.63	0.62	—	—
9 ...	—	—	—	—	3.03	0.02	—	2.13	—	—
10 ...	—	—	0.30	—	1.84	—	—	1.88	—	—
11 ...	—	—	1.35	—	0.10	—	—	1.76	—	—
12 ...	—	—	—	—	—	0.52	—	0.17	—	—
13 ...	—	—	—	0.26	—	—	—	0.02	—	—
14 ...	—	—	—	0.09	—	—	—	0.12	—	—
15 ...	—	—	—	—	0.27	—	—	0.01	—	—
16 ...	—	—	—	—	0.04	—	—	—	1.35	—
17 ...	—	—	—	0.73	0.06	0.20	0.03	—	0.12	—
18 ...	—	—	—	—	0.01	—	—	—	—	—
19 ...	—	—	—	—	0.02	—	—	—	—	—
20 ...	0.11	—	—	—	0.23	—	1.07	—	0.04	—
21 ...	—	—	—	0.01	0.57	—	0.44	—	0.01	—
22 ...	—	—	—	0.17	—	0.01	—	—	0.16	—
23 ...	—	—	—	0.01	0.58	0.01	—	—	0.06	—
24 ...	—	—	—	—	0.01	—	0.56	—	0.01	—
25 ...	—	—	—	—	—	—	0.51	—	—	—
26 ...	—	—	—	—	—	—	—	0.21	—	—
27 ...	—	—	—	—	—	0.12	0.01	—	0.41	—
28 ...	—	—	—	0.24	0.36	—	2.85	—	—	—
29 ...	—	—	0.02	0.56	0.03	1.16	0.16	—	0.06	—
30 ...	—	—	—	0.04	—	0.01	0.03	—	—	—
31 ...	—	—	—	—	—	—	—	—	—	—
Total ...	0.29	0.00	1.72	2.67	7.72	2.45	8.54	11.42	3.40	2.38

Total rainfall for year = 40.59 inches.

PLANT PHYSIOLOGICAL WORK.

BY

D. F. RUSTON.

Rotation Experiments.—The rotation experiments on the loam and granite soils were continued as before, the experiment on the loam soil being now in its fifth year.

The experiment is designed as a trial of six different two-year rotations, each rotation including cotton. The experimental area comprises two fields, one field being planted to cotton each year, while the other field is under the six different rotation crop treatments (cotton, fallow, maize, sunflowers, tepary and soya beans). In the following season these treatments are reversed, rotation crops being planted after the cotton, and cotton following the rotation crops.

Loam Soil. Sub-experiment A.—This field received a dressing of superphosphate at the rate of 200 lbs. per acre at the beginning of the season, the first application of any fertilizer to the field since the experiment was laid down in 1932. Planting took place on November 14th, 1936, acid-treated seed of 052 cotton being used.

Samples taken on December 18th, for green and dry weights, showed cotton grown after sunflowers to be significantly better than cotton following tepary beans, fallow and soya beans in weights per plant, while height measurements, taken a few days after, also showed the sunflower treatment to be significantly better than those of fallow and soya beans.

Height measurements were taken at monthly intervals from December 21st to March 22nd. Cotton following sunflowers gave the tallest plants in December and January, but the fallow treatment took the lead in February and went further ahead in March, when the height per plant for this treatment was significant over all other treatments except sunflowers.

HEIGHT PER PLANT CMS. MARCH 22ND.

Fallow	Sunflowers.	Tepary beans.	Maize.	Cotton.	Soya Beans.	Diff. req. for Significance.	
						P = .05	P = .01
93.8	88.7	83.2	73.5	80.5	69.1	7.0	9.4

Flower counts were made daily on sample rows from all treatments, commencing at the end of January and continuing till the end of March. Cotton following fallow was one of the latest to start flowering, but by the end of February it had caught up with the other treatments and increased its lead steadily from then onwards, finishing with over sixty flowers per plant.

NUMBER OF FLOWERS PER PLANT.

<i>Fallow.</i>	<i>Sunflowers.</i>	<i>Tepary beans.</i>	<i>Maize.</i>	<i>Cotton</i>	<i>Soya beans.</i>
60.8	57.8	53.1	47.4	47.9	41.6

Picking commenced on April 21st and was continued, at intervals, till July 8th when a final clean-up was taken. The yields from the experiment were high, the early planting and good rainfall, combined with the addition of phosphate, increasing the yield to over three times that of the previous season.

It was suggested in the last report that the beneficial effect of fallow might be partly due to the lesser drain of phosphates on the fallow plots. If that is the case, then the application of 200 lbs. superphosphate to the field at the beginning of the season has not been sufficient to counteract the drain of phosphate from the other plots in the last five years, as the superiority of the fallow treatment was just as evident this year as in previous years.

YIELDS SEED COTTON (LBS. PER ACRE).

<i>Fallow</i>	<i>Sunflowers.</i>	<i>Tepary beans.</i>	<i>Maize.</i>	<i>Cotton.</i>	<i>Soya Beans.</i>	<i>Diff. req. for Significance.</i>	
						<i>P = .05</i>	<i>P = .01</i>
1286	1051	938	758	728	715	240	325

A graph showing yields per plant (based on a full stand) for the six different treatments is shown in Figure 1. This agrees with the height measurements and flower counts in showing that it is in the later stages of development that the benefits of fallow are most evident, the early growth being somewhat retarded in comparison with the other treatments.

At each picking samples were taken from all plots to find the average boll weight for each treatment. The yields per plant, at each picking, were then converted by the boll weights to get an estimate of the number of full bolls picked per plant.

FINAL NUMBER OF FULL BOLLS PER PLANT.

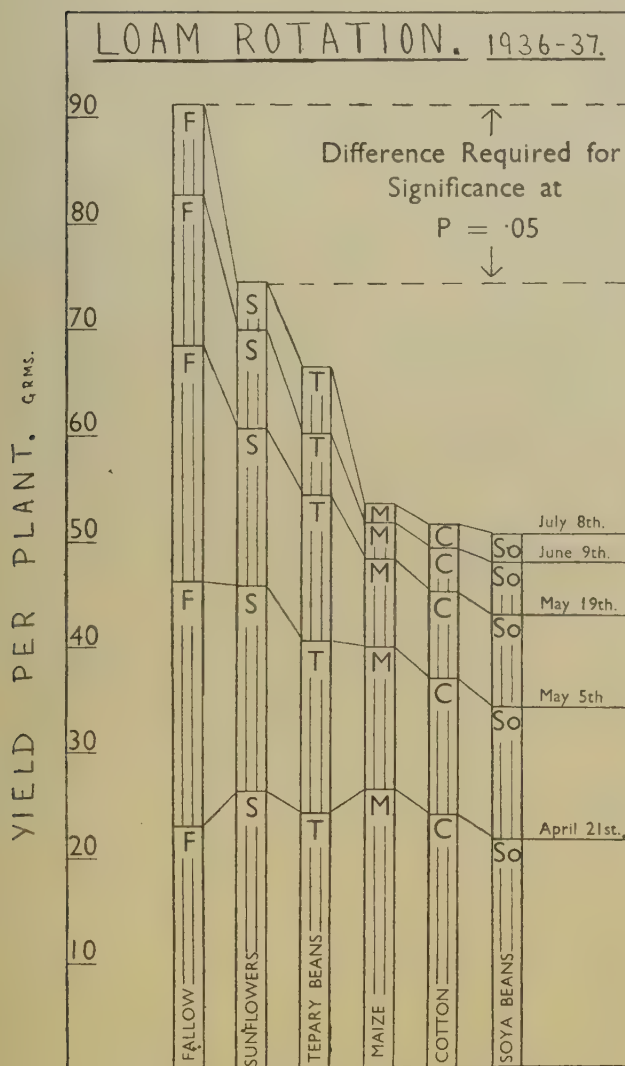
<i>Fallow.</i>	<i>Sunflowers.</i>	<i>Tepary beans.</i>	<i>Maize.</i>	<i>Cotton.</i>	<i>Soya beans.</i>
18.50	15.65	14.57	11.87	10.93	10.86

Cotton following fallow not only gave the highest boll weight at each picking, but it also gave the highest final number of full bolls per plant.

From the figures for the number of flowers per plant, and the estimate of the final number of full bolls per plant, a figure representing the proportion of full bolls picked to flowers produced was worked out.

FULL BOLLS PICKED AS A PERCENTAGE OF FLOWERS PRODUCED.

<i>Fallow.</i>	<i>Sunflowers.</i>	<i>Tepary beans.</i>	<i>Maize.</i>	<i>Cotton.</i>	<i>Soya beans.</i>
30.42	27.06	27.42	25.02	22.80	26.09



Cotton following fallow shows to advantage in this respect also, as not only has it more flowers per plant than any other treatment, but a greater proportion of these flowers form fully open bolls. Cotton following cotton seems very bad in this respect, only 22.8% of what may be called its potential crop being brought to maturity.

Ginning percentages were taken on the second and third pickings, cotton following fallow giving the highest ginning percentage in both cases, but as the samples taken were composite samples from the six plots, the significance of the differences in ginning percentages could not be worked out.

Some of the factors which contribute to the increased yield of cotton following fallow may be briefly enumerated.—(1) Taller and stronger plants. (2) More flowers per plant. (3) A larger proportion of these flowers come to maturity. (4) Greater boll weight.

There is also an indication that the ginning percentage may be raised slightly through the better growth, and it is hoped to test this more fully next season.

Loam Soil. Sub-Experiment B.—This field of the Loam Rotation Experiment was under the six rotation crop treatments.

The yield from the cotton plots averaged 570 lbs. seed cotton per acre, a considerable improvement on last year's yield, though falling a long way short of the yields of cotton following cotton on the neighbouring field. No doubt lack of phosphate was responsible for this, as this field did not receive phosphate before planting. Of the other rotation crops, sunflowers and teparies gave average yields, but soya beans, and maize in particular, were poor, the latter suffering very badly from streak.

Deep soil moisture samples were taken on the rotation crop plots early in July, samples being taken at intervals of one foot, from two feet down to five feet. The mean of these four depths showed the fallow plots to have the greatest reserve of subsoil moisture, with an average of 19.2%. The soya bean plots were the driest with a moisture content of 16.6%, this difference, however, was not significant.

Granite Soil.—Sub-experiment A was planted with 052 cotton on October 19th. Excellent yields were obtained, the fallow treatment being significant over all others for the first time since the experiment was started.

YIELDS SEED COTTON (LBS. PER ACRE).

Fallow	Sunflowers.	Tepary beans.	Maize.	Cotton.	Soya Beans.	Diff. req. for Significance.	
						P = .05	P = .01
1390	1207	1190	1169	1062	1246	137	189

The difference in the growth of cotton after soya beans on the loam and granite soils is probably due to the fact that the beans nodulate on the granite soil (where experiments have shown nitrogen to be very advantageous to the growth of cotton) but not on the loam soil.

Sub-experiment B was under the six rotation crop treatments, all of which made fair growth.

Potash-Nitrogen Experiment.—This experiment, a repetition of the one carried out the previous year, consisted of nine different treatments, these being N.0, N.1, and N.2, combined in all possible combinations with K.0, K.1, and K.2. The dressings 0, 1 and 2 being respectively Nil, 200 and 400 lbs. per acre with each fertilizer.

The potash was applied in September, but the nitrogen was given as a top dressing about a month after planting.

Samples were taken for heights of plants seven weeks after planting and again ten weeks after planting, but no significant differences were observed. At the time of the first picking, early in May, the whole field looked very uniform, and the yields from the picking showed no appreciable differences. Thereafter, however, it was noted that the Nil plots in particular seemed to fall away rapidly, while the heavily manured plots continued fruiting and remained comparatively green and fresh.

The final yields showed a significant difference in favour of the heavily manured plots, but there was no indication of any interaction between the manures, and the theory that nitrogen might depress the yield when without potash and increase it with sufficient potash does not seem to hold.

N.2, K.2 gave 1384 lbs. seed cotton per acre, while the Nil plots N.0, K.0 gave 1027 lbs.

ROTATION CROPS.

BY

M. F. ROSE.

General.—The season, very early as compared with the preceding one, opened with great promise: good, early rains, evenly distributed, favoured all early plantings and excellent stands were obtained. The final yields, however, were lowered by the abnormal rainfall of the New Year, 20 inches in January and February adversely affecting all crops, especially sunflowers and soya beans.

MAIZE: (*a*) *Variety Trials.*—Five variety trials, ranging from very early to late, were planted on the Station during the season: full data are given below.

YIELDS (LBS. PER ACRE).

<i>Soil type.</i>	<i>V.T.1 Granite.</i>	<i>V.T.2 Loam.</i>	<i>V.T.3 Granite.</i>	<i>V.T.4 Loam.</i>	<i>V.T.5 Loam.</i>
<i>Planting date</i>	19/10/36	14/11/36	1/12/36	31/12/36	23/1/37
<i>Strain and Spacing—</i>					
Hickory 18" ...	2450	3178	—	2621	—
" 24" ...	2121	2783	—	2276	—
" 36" ...	1740	2121	—	1842	—
Anveld 18" ...	2277	3359	1775	1772	300
" 24" ...	2347	2944	1244	1597	265
" 36" ...	1629	2186	1118	1245	199
Morgenster Marvel 18" ...	1966	3315	1310	2221	416
" 24" ...	2077	2871	1453	1775	350
" 36" ...	—	—	1175	—	231
Am. white flint. 18" ...	2199	3198	1812	2356	328
" 24" ...	1995	2835	1324	1972	277
Peruvian 12" ...	—	—	1603	—	893
" 18" ...	—	—	1604	—	824
Diff. reqd. for 5% pt. ...	Non-sign.	210 lbs.	280 lbs.	379 lbs.	74 lbs.

All inter-row spacing constant at 36".

An unusual feature of the results is that Hickory, the longest duration type, yielded well when planted at the end of December, no doubt owing to the season being wetter than usual. Peruvian on the other hand, the most drought-resisting and earliest type, did not yield as well as usual in the latest planting. Peruvian is inclined to lodge, even in a normal season, and this failing was particularly marked with moister conditions.

The usual superiority of the 18" inter-plant spacing over the 24" was again in evidence, as also the sharp fall in yield between the 24" and 36" spacings.

(b) *Residual Effect: Inorganic fertilisers.*—Maize (Am. White Flint) followed tepary beans which, in the 1935–36 season, had been superimposed on the permanent cotton fertiliser experiment. The yields of tepary beans and the quality and quantity of fertilisers applied (to cotton) were given in the previous report.

It was desired to ascertain what effect the fertiliser residues (if any) had on the maize crop—(a) in the early stages of growth, (b) in terms of final yield.

The crop, planted on December 9th, was sampled on January 5th. Figures for green weight, dry weight and final yield are shown below.

					Gms. per plant.		Yield (grain).
					Green wt.	Dry wt.	Lbs. per acre.
P.2	...	...	...	...	47.7	6.6	2884
P.1	...	...	...	...	37.8	5.10	2476
KPN	...	...	...	...	33.5	4.4	2635
K	...	...	...	...	24.8	3.1	2143
Nil	...	...	...	...	24.3	3.0	2012
Diff. for 5% pt.	...	...	...	...	6.2 gms.	1.2 gms.	368 lbs.

The importance of phosphate to the crop is apparent from the above figures: these are in the same order as those obtained for tepary beans in 1935–36 and for cotton previous to the beans.

(c) *Residual Effect: Organic manure.*—Kraal manure, at the rate of 5 tons per acre, was applied in the winter of 1935 to a randomized block experiment with cotton: the subsequent yield of seed cotton from the manured plots was almost double that of the controls.

On November 14th, 1936, maize was planted over these plots: marked differences in growth were soon apparent and the plots were sampled for green and dry weights on December 9th: the results, with final yield figures, are shown below:—

					Gms. per plant.		Yield (grain).
					Green wt.	Dry wt.	Lbs. per acre.
Kraal manure	...	...	...	...	24.0	2.9	3003
Nil	...	...	...	...	15.8	1.7	2932
Diff. reqd. for 1% pt.	...	...	...	...	2.8 gms.	0.46 gms.	Non-sign.

The marked differences in vegetative vigour between the Nil and the manured plots was apparent throughout the whole of the growth period of the crop. No explanation can be offered as to why the final yield figures of both treatments were the same.

(d) *Stooking*.—The stooking of maize before absolute maturity is reached is not commonly practised in the Barberton district. The procedure has several commendable features:—(1) It ensures against early lodging and consequent white ant damage. (2) With late planted crops, it enables the farmer to utilise the fast-diminishing soil moisture for winter ploughing with the stooks still standing upon the land. (3) Presupposing a critical date for stooking, after which no serious loss in yield will be experienced, it affords a “time” period for reaping operations.

With the object of finding this critical date, a field each of American White Flint and Hickory was planted on December 31st, the intention being to cut the crop at various stages of development of the grain. Unfortunately the streak disease attack was so severe on these late plantings that they were discarded and recourse had to an early November planting of American White Flint only. The results are shown below:—

shown below :—

AMERICAN WHITE FLINT.						
Cutting.				Days from peak of tasselling phase.	Yield lbs. per acre.	Seed wt. (gms.) per 100 seed.
1	...	...	...	47	2141	34.4
2	...	...	...	54	2814	38.7
3	...	...	...	61	2839	41.2
4	...	...	...	68	2829	41.1
5 (Normal-hard grain)	...	...	...	78	2987	42.9
5% diff.	...	...	...		395 lbs.	
1% diff.	...	...	...			0.9 gms.

Owing to the wet season the development of the grain was slower than usual and the above results must be accepted with reserve. Thus in a normal season, cutting 1 (47 days from the peak of the tasselling phase) might reasonably yield the same weight of crop as cutting 2.

(e) *Streak Disease*.—There appears to be a close connection between this disease and the nature of the early rains. In the previous season the spring rains were light and very late and there was extremely little streak throughout the season. In this season the rains were very early and abundant and the attack of streak was the worst ever witnessed on the Station. Early December plantings of susceptible strains showed about 66% of infected plants by the end of January. A field of American White Flint, planted on December 31st, was very badly damaged: counts made in February showed only 23 non-infected plants in a total of 21,300.

This heavy attack was very opportune in furthering the selection work for streak-resistance and the 710 selfed lines of various varieties from the previous season yielded valuable material. Peruvian has always shown a high degree of resistance and the selections from this variety gave many very good lines. Of the 20 best lines, for which figures are given below, there were 9 in which there was no infected plant. Hickory, which normally shows fair resistance, gave some very promising lines but none in which the whole 100% of the plants showed no infection. The figures given below of streak counts on the best 20 Hickory selections compared with ordinary bulk show the very marked shift of frequency, from "heavy" and "medium" to "light" and "nil" classes of infection, brought about by selection. There was no bulk of Peruvian from which strictly comparable figures could be obtained, but the increased resistance of the best lines was very evident from general observations.

STREAK DISEASE INFECTION.

<i>Strain.</i>	<i>Total Plants counted.</i>	<i>Percentages of Degrees of Infection.</i>			
		<i>Nil.</i>	<i>Light.</i>	<i>Medium.</i>	<i>Heavy.</i>
Peruvian, best 20 lines ...	787	98.2	1.5	0.13	0.13
Hickory, best 20 lines...	637	61.1	27.5	6.7	4.7
Hickory, ordinary bulk ...	655	14.9	16.4	30.7	38.0

In the case of American White Flint, the most susceptible strain grown on the Station, there was no evidence of improvement in the resistance of selfed lines and further work on this variety will be dropped. As an example of the damage it suffered, it may be stated that the field referred to above, in which practically all the plants were infected, gave a yield of only 442 lbs. per acre of poor grain as compared with 1740 lbs. per acre of good grain from a field of Hickory planted at the same time.

An attempt is being made to combine the very high resistance of Peruvian with some of the important economic characters of Hickory. Thirteen crosses have been made between the best selfed lines of these two varieties and it is hoped that valuable material for further selection and crossing work will be obtained.

Previous crosses and back-crosses between Peruvian and Hickory, as also Peruvian and American White Flint, have yielded interesting material. Simple mendelian ratios have been observed for colour of endosperm and type of seed, but the resistance to streak appears to be of a complicated nature.

TEPARY BEANS.—The tepary spacing experiment—Broadcast versus Drilled—was continued for a second season on both loam and

granite soils. In each case the broadcast plots received treble the seed rate of the drilled; the beans of the January 1st planting, however, were thinned out in the seedling stage. Subsequent sampling over the thinned plots showed that the stand was practically double that of the drilled. All relevant data are shown below :—

<i>Date planted</i>	<i>Treat.</i>	<i>Seed rate lbs. per acre.</i>	<i>Area per plant (sq. ins.)</i>		<i>Yield lbs. per acre.</i>	<i>Sign diff. 5% pt.</i>	<i>Seed wt. gms. 100 seed.</i>	<i>Sign diff. 5% pt.</i>
			<i>Expected</i>	<i>Realised</i>				
1/1/37	" B "	27 × 2	32	31	1012	non-sign.	10.42	" Z "
	" D "	27	64		923		11.17	sign.
7/1/37	" B "	27 × 3	21.3	19	1124	157	10.14	" Z "
	" D "	27	64		918		10.80	sign.

In spite of the wet season and profuse growth the beans again showed themselves tolerant of a very close spacing. The profuse growth of the beans, however, did not suppress weed growth and it is doubtful whether the small extra yield from the broadcast plots offset the fouling of the land: broadcasting of tepary beans should not be regarded as the rule in good farm practice, only as a last expedient in a very late season.

SUNFLOWERS.—St.3.bk. was grown on the rotation plots (loam and granite) and B.4.bk. (with sub-strains selected from it) was grown alongside St.3.bk. in observation plots: the heavy rainfall affected all strains adversely and seriously reduced the yield. The rotation plots (loam) yielded at the rate of 1,100 lbs. per acre instead of the customary 1,600 lbs.: the granite returned a yield of only 800 lbs. per acre.

SOYA BEANS.—The strain Yellow 1 appeared on the loam and granite rotation plots only: like sunflowers, the beans were affected by the February rains and yielded poor crops of inferior quality.

INSECT PEST WORK.

Members of the staff of the Insect Pest Control Section were engaged for considerable periods from March to July in discussions at Barberton and on tours in the Union, Swaziland, the Rhodesias and Nyasaland with Dr. J. W. Munro, Professor of Zoology and Applied Entomology in the Imperial College of Science and Technology, London, in connection with his review of the Corporation's insect work. Professor Munro's visit was warmly welcomed and his commendation of the work and recommendations for its expansion have afforded the keenest appreciation and satisfaction.

Mr. B. L. Mitchell joined the staff in October. He will undertake red bollworm work in Nyasaland after spending about ten months at Barberton.

Mr. Gaddum of the Kenya Agricultural Service obtained an insight into the work of this Section during a period of several months' study of cotton work at the Experiment Station.

1. INVESTIGATIONS ON THE AMERICAN AND RED BOLLWORMS.

BY

F. S. PARSONS, H. HUTCHINSON AND J. MARSHALL.

AMERICAN BOLLWORM.

Infestation Records.—Continuous recording of bollworm incidence on farms in the Barberton, Swaziland and Magut areas was discontinued as a routine measure from December of last year. This part of the insect pest work was instituted to acquaint us with the annual course of bollworm activity in the field along the various paths of enquiry that have already been indicated, with results, in the 1932-33 and subsequent Reports. Repetition of much of the recording is now unwarranted as in the five years since its inception we have recognized a regularity in calendar time of the main features of the succession of events. It is still required at Barberton to apply the system of survey in full to a comprehensive example of (1) a winter-breeding area, (2) the period of breeding on weeds and early summer (irrigated) crops and (3) a summer-breeding area. Retention of the survey to this extent ensures continuity in the supply of pupal material from which moth flight data are procured, which are yielding valuable information on the following lines. The emergence of moths is recorded from pupæ derived from representative samples of mature larvæ collected continuously from all sources in the field, thus providing in miniature a course of emergence comparable to that occurring in nature. It may be explained that in the construction of moth flight

graphs each individual moth is retained in the picture for the duration of the mean laying-life applicable to the ruling climatic conditions, and in some instances to the food-crop from which it has been bred, as determined from parallel laying and feeding tests in the insectary (the influence of temperature and food on longevity and fecundity is very considerable): the graph of aggregate moths so obtained fits very closely to the course of laying recorded in the field. As the origin of all moths is recorded, we may plot separately the moths from each main breeding ground in the annual cycle, *i.e.* (1), (2) and (3) above. Such analyses shew that the first attack on cotton and other summer crops is due principally to the moths from (2) and that the extent of their intervention is governed by the earliness of the planting season; only if the rains are exceptionally early will the summer crops be laid on by moths in the tail end of the flight from (1). Considering now the three following points (*a*) that there is little departure in calendar time from the span of these separated flights, (*b*) that the laying moths commence to deposit eggs on crops as these come into flower, and (*c*) that the period between planting and flowering varies but little, we may estimate fairly closely when and what proportion of moth flight No. 2, and possibly of No. 1, will fall on the summer crops (they being practically the only food-plants then present in abundance). These are valuable timing relationships that are now being utilized in planting alternative and preferred food-crops of the moth in order to alleviate the primary attack on cotton; they also afford opportunity to apply insecticides more usefully, especially in view of information recently obtained on the course of larval mortality in cotton, as stated later.

Apart from their importance in establishing the complicity of different flights of moths, most of the records now being taken in the restricted areas are utilized also in investigations on particular relationships of the bollworm with its food-plants to which attention has become increasingly directed since their recognition. The investigations in progress are as follows:—

Studies on Mortality and Nutrition.—It has been realized for some time that the weight of egg-laying is not a reliable indicator of the breeding propensity of a crop. One endeavour has been to define the chief source of breeding prior to the cotton-growing season and later, during the cotton season, to obtain evidence that in manipulating the plantings of maize and other familiar crops, or the insertion of new crops in order to attract moths from cotton, we have not thereby increased the total bollworm population. Added importance is attached to this with regard to summer crops because there one attempts

to fit the alternative crops into the scheme of things so that they will be in flower and serve to divert moths, particularly when flight No. 2 and the first flight from their progeny are at the maximum. Thus, if larval survival on the counter-attractant crops were higher habitually than it is on cotton the best opportunity would be provided for an extra multiplication of bollworm moths that might infest cotton later in the season. The counter-attractant crops used against flight No. 2 may be short-flowered, thus rapidly losing attraction, and it may not be possible or practicable to use later timed plantings of them to divert the subsequent summer flight, hence cotton with its long-flowering habit may experience an unduly heavy late attack, particularly damaging as the plant then has less opportunity of recovery. For these reasons it has been necessary to study mortality in the egg and larval stages on all the food-crops concerned and some findings are given here.

Larval survival on maize, our principal alternative food-crop, appears to be 30–50% lower than it is on cotton so that, apart from the relief in weight of oviposition diverted at any time from cotton to maize, fewer moths will result per unit quantity of eggs laid on maize than on cotton. The same assertion holds true for groundnuts, one of the few food-crops on which the larvæ are purely foliage feeders. The strains of chick pea, *Cicer arietinum*, with which we have been experimenting are most attractive to the egg-laying moth, but, unfortunately the larval survival over the whole range of the egg-laying is inordinately high and the presence of this crop leads to a high multiplication of the bollworm. The chick pea plant, although it flowers indiscriminately, loses attraction quickly if the growth conditions are difficult and then fails to hold the moths bred in the crop: a steep rise in March of the oviposition at Bremersdorp, Magut and Barberton coincided with the flight of moths from the pea areas at the three places. The plant is not tolerant of arsenical dusts and on the whole the present strains are apparently unsuitable for counter-attractant purposes, but they and other types of *Cicer arietinum* will be observed further as there are several notable points in the relationship of *Heliothis* with them which receive mention below as examples of the variable influence of crops and different strains of the same crop on the insect with respect to attraction, nutritional value, mortality and associated factors.

It is necessary to emphasise the importance of the relationship between egg-laying and flowering. This has been witnessed so often over a period of years on the crops normally grown that we no longer seek or expect to find eggs on these crops prior to the onset of flowers.

The moth does, however, oviposit on chick peas at all stages of the plant's growth and, another departure from the usual, there is no distinct high laying period when flowering is at the maximum. This is an important exception to the general assumption that the basis of attraction is the flower or flowering stage. The bollworm larvæ are able to mature on the chick pea foliage alone, an exceptional feature of importance in the nutritional work, and there is an uncommonly and continuously high survival to the pupation stage of larvæ from eggs laid throughout the whole period of oviposition. Larvæ bred on a purple-flowered variety yield a small, light-weight pupa giving issue to a diminutive moth with corresponding egg production, whereas the pupæ and moths from larvæ bred on a white-flowered variety are equal in dimensions and capacity to those bred on cotton or maize, which we take as standards: it is suspected that this difference is due partly to the influence of the acids in the chick pea food on the amount of fat body laid down in the pupa. There are other but rather inconstant differences between these two varieties in the rate of growth of larvæ and in the percentages of larvæ that attain pupation in the field.

It appears from analyses of larval mortality in cotton that there may be a valuable limitation to the period when bollworm in cotton may be attacked directly with most profit, to wit:—on reference from the larvæ back to the eggs producing them there was found to be a very high survival from a relatively small fraction of the *initial* egg-laying, thereafter mortality increased tremendously as the following figures reveal; the figures are from consecutive bases of eggs at 4-day intervals:—percentages of larvæ attaining maturity, 21, 17, 9, 7, 7, 5, 5, 4, 2, 1, 1, 0, 0, 0. Similar results were obtained in two investigations, one at the Cotton Station, Barberton, and the other on a farm in the district. Further analyses indicated that the mortality was proportionately heavy over all the growth stages of the worm, hence there was a concentration in point of time of the really damaging section of the infestation. If these circumstances are habitual, then it is possible to estimate, from the combined information referred to earlier in the three timing relationships, when to apply direct measures, *i.e.*, insecticides to European-grown cotton, and hand collection in plots of native-grown cotton. The falling-off in larval numbers (many of the low survivals date back to the periods of heaviest oviposition) is not explicable on nutritional grounds, but it may be due to cumulative natural control by predators and it is proposed to investigate that subject in conjunction with extended studies of mortality in cotton.

The course of bollworm-breeding in the off-season of cotton-growing and the procession of events leading to the appearance of moths in rain-grown crops have received further attention from three angles, (a) mortality in field crops, an intensive study, (b) growth-development of larvæ as fed in the insectary on mixed flower and fruit material from individual crops and on caged growing plants, (c) with the guide of the synchronization in flowering and oviposition, larvæ were fed on the class of food that the plant provides in the field to larvæ from successive egg hatchings; it will be apprehended that the quality of the food changes with development of the plant. As a preliminary to this work the periods of bud, flower and fruit development of all the crops were measured in order to simulate the natural train of events in insectary-feeding experiments. Combining this information with knowledge of the dates of egg hatching and of the stages of larval growth attained during the same period from each batch of eggs, we obtain knowledge of the character of the food required by the larvæ or available to them. It is clear from repeated studies that the tomato and cucumber crops contribute extremely few or no moths and as these sources comprise as much as 30% of the winter feeding area the supply of summer moths is limited correspondingly. For this reason control measures may be directed principally to the other winter crops, the pea, marrow and bean crops in order of their food value for the caterpillars. The nutritive value of the food available is a determining factor in survival: the feeding tests and field records are in close agreement on this, and as at the time of year concerned predators and parasites are least active, more significance can be attached to this agreement. It is fairly evident that in most instances access to developed green ovules is necessary for normal metabolism; to that extent we can assess the nutrient requirements of the insect, especially the effect of diet on pupal weight with concomitant effects on moth size and fecundity. Size and fecundity have an important bearing on the subsequent generation.

Analyses of Crop Loss in Cotton.—A preliminary attempt has been made to assess the loss due to American bollworm from different quantities of egg-laying on different cotton crops. The problem was approached by recording as nearly as possible the history of all bud, flower and boll material set during the life of each plant in the samples taken. The work is proceeding.

Studies in Attraction.—Work on this subject was confined to tests of the influence, as food, of sugar solutions (artificial nectar) on mating and egg-laying. The only comment at present possible is that fertile eggs are not deposited unless the moths acquire food at regular intervals.

RED BOLLWORM.

At Barberton investigations are continuing on the long pupation phase entered upon by a small proportion of the over-wintering pupæ. It is moths from this fraction of the over-wintering pupæ that serve to maintain a small pest population in the higher-lying cotton-growing areas of the Union and Swaziland, despite the abolition of ratooning and the absence of natural food-plants. The evidence obtained on the amount of such delayed emergence together with further information on the longevity and oviposition life of the later-emerging moths, is rendering possible the proper assessment of the extent to which these moths from carry-over pupæ can intervene when plant cotton is capable of supporting larvæ, thus initiating the season's infestation. There is evidence that a somewhat larger and more protracted amount of early laying may occur than was judged formerly to be the case, especially in early-planting seasons. Notwithstanding this, provided proper closed seasons are adhered to, the pest should not exceed a minor status, although there are possibilities of an accumulation in some years of unusual proportions of long-pupating forms that could occasion a year of greater numbers of the bollworm: the pupation work should supply information on this point.

It has been learned that lack of food and water do not exert a significant influence on the length of life, egg-laying habits and egg-laying capacity of the moths.

The Work at the St. Phillip's Field Station, Swaziland and the Pongola Irrigation Settlement, Magut.—The project, referred to in the previous Report, of planting cotton under irrigation early in the warm season proved unpromising, as the development of both plant and red bollworm infestation runs parallel with that of *Cienfuegosia Hildebrandtii*, and, in effect, the presence of the early cotton only serves to breed an ultimately heavier bollworm population, an additional drawback being that the cotton grows on in a ragged fashion without ripening a definite crop. On the other hand the plants in the April or end-of-season planting made so little advance in growth prior to the early spring warmth and rains that they would encounter much the same conditions and aftermath as apply to the above early plantings. Principal plantings on January 31st in one instance and mid-March in another, with subsidiary test plantings between these dates, have been substituted for the above: these should be more promising according to information from the St. Phillip's Station on the course of moth flight from the over-wintering pupæ in natural food-plant sites and to expectations of better and definite cropping of the cotton plant before the natural food-plants resume fruiting and breeding.

Larval Mortality on Cienfuegosia and Wild Cotton.—It is interesting to record that the course of larval survival on both food-plants was very similar to that on plant cotton at Barberton, namely a high initial survival with rapid decreases, the high egg-laying periods being least productive of mature larvæ. As intimated last year, more larvæ carry through to pupation on *Cienfuegosia* than on wild cotton; the respective percentages lately calculated being 3·75 and 2·95; the former food-plant is also more numerous and widespread than the latter.

The Seasonal Course of Infestation of the Natural Food Plants.—The main flight of moths from the over-wintering pupæ occurred between August and January 8th, with peak periods in November and December; by January 8th 80–90% of all moths from this source had emerged. Fruit of *C. Hildebrandtii*, capable of sustaining larvæ is present in increasing abundance from August onwards and there is an extremely large early-season multiplication and correspondingly early appearance of moths bred within the season.

Wild cotton produces very little flower and fruit material before the end of December, and although the course of flight from the over-wintering pupæ is the same and a few eggs are deposited, the early-season breeding is negligible. Presumably, if colonies of *C. Hildebrandtii* are at hand the moths emerging between August and early January in the wild cotton areas migrate to *Cienfuegosia* food-plants, and it may be concluded that they do so because if fruiting host plants are *not* present in a neighbourhood the moth lays freely even on naked cotton stalks. It is assumed from the difference in fruiting behaviour between the two food-plants that in areas where *Cienfuegosia* is not present, *e.g.*, the cotton-growing areas in the North-Eastern Transvaal, the infestation develops on a lower plane and much later in the season.

C. Hildebrandtii is oviposited on heavily from November to April inclusive, wild cotton from January to April inclusive. Both plants boll heavily after the cessation of moth activity, but it would appear from records of flowering and bolting that, irrespective of previous bollworm damage, it is the habit of wild cotton to produce much the greater proportion of its bolls in April and May after oviposition has declined. The results obtained at St. Phillip's and at the Pongola Settlement are shedding considerable light on the rôle of each of the natural food-plants in the seasonal breeding of this pest, and it is largely on this information that the programme of planting at the latter place has been modified.

II. INVESTIGATIONS ON COTTON STAINERS AND INTERNAL BOLL DISEASE.

BY

E. O. PEARSON.

During the past year recording work on wild host plants and in the crop has been carried out under Mr. Hutchinson in Swaziland and under Mr. Bowmaker in the Magut district.

The writer visited Northern Rhodesia with Professor Munro and Mr. Parnell in May and June. Much benefit has been felt from the interchange of views with workers in that country and from the discussions which took place during the whole of Professor Munro's visit.

Observations on Wild Host Plants.—The records on representative colonies of *Sterculia Rogersii* instituted in 1934 have been continued in all districts. The crop set last year was above the average and was comparatively free from damage by the Noctuid moth previously recorded. The usual immigration of adult *D. intermedius* took place in late October–November, in some cases being extremely large. Correspondingly large populations of 5th instar nymphs were built up during December, but in most cases they dispersed from the trees as soon as they became adult. *D. nigrofasciatus*, however, occurred in one locality only, in December, and elsewhere failed to appear on the trees, as in three out of the last six years.

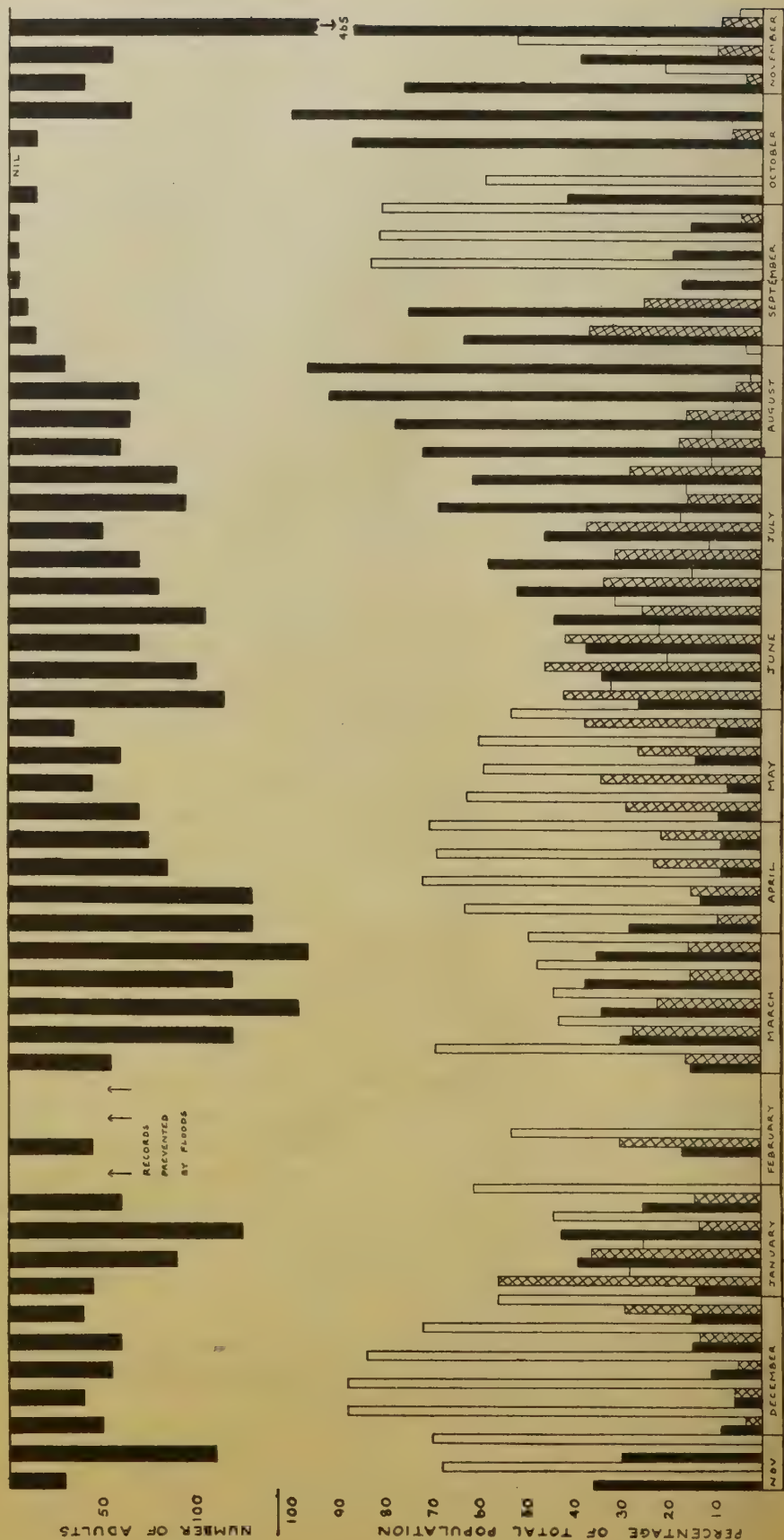
From these careful and now long-continued observations on this tree it is clear that whilst it constitutes the most important host of *D. intermedius*, as is the case with other species of its genus in Nyasaland and the Rhodesias, it is not, in spite of its great abundance, a regular item in the food cycle of *D. nigrofasciatus*.

The past year has seen a great advance in our knowledge of the regular host plants of the latter species. The late rains of 1936 and the early and abundant rains of the 1936–37 season made available an ample supply of host material and the method of recording populations on groups of herbaceous hosts along regular beats has been improved and extended to tap typical vegetation areas in all districts.

The course of events on the most important of these hosts in the Barberton district is shewn in the accompanying diagram. The actual number of adults recorded each week is shewn in the upper part of the diagram: these numbers are the sum of all adults recorded on nine beats scattered at intervals over a distance of about thirty miles down the de Kaap valley.

Comparison of the figures for 1936 and 1937 shew in each case a sudden rise in adult population in November, following the break of

POPULATION OF DYSDERCUS NIGROFASCIATUS ON HIBISCUS CALYPHYLLUS, BARBERTON 1936-7



the rains. In 1936-37 the population subsequently reached maxima in late January, late March and early June, thereafter fluctuating considerably, but in general declining until from the end of August to late October the population was extremely small. This suggests a general immigration in November followed by peaks due to successive generations maturing at intervals of about eight, nine and ten weeks respectively, the maturation period increasing with seasonal fall in temperature and the duration of the generation being correspondingly lengthened.

The observed population figures suffer from considerable fluctuations due to the smallness of the samples, personal errors amongst the recorders and the fact that weather variations affect the activity of the stainers and hence the ease with which they are recorded. If these variations are removed by expressing the numbers of each stage as a percentage of the total population recorded on each occasion, as in the lower part of the diagram, the successive generations may be more clearly demonstrated. The maxima for percentage of adults approximately coincide with the maxima for absolute numbers of adults and are preceded, in the case of the January, March and August maxima, by similar maxima for percentage of 5th instar and are followed, in the case of the November, January and March maxima, by similar maxima for percentage of young nymphs.

From the end of May there is a strong decline in the proportion of young nymphs, the population from June to early September being largely composed of adults and slowly maturing 5th instars. One factor causing this is the decline in the proportion of the adult population existing as mating pairs from May to August; another is a probable failure of eggs to incubate in the conditions of low temperature and humidity then ruling. In late September and early October there is a sudden rise in the proportions of young nymphs (chiefly 2nd and 3rd instars), but these do not give rise to 5th instar nymphs, probably on account of insufficient available food, and the sharp rise in proportions and actual numbers of adults in late October-early November is clearly due to fresh immigration.

The above data are derived from a host plant which, existing in comparatively secluded localities, has a particularly prolonged growth and fruiting period, but the same general phenomena are observed on all the herbaceous hosts, more or less modified by the nature of their fruiting and growth habits.

Thus, on *Hibiscus vitifolius*, *Hibiscus* sp. near *H. mutatus*, and *Abutilon* spp., occurring in much more exposed situations, the population declined, in some cases sharply, after the end of the rains

in April; on *Hibiscus asper* which is an annual, not ripening fruit until early April, immigration of adults did not occur until then and a single generation was matured in June.

The curves described above are obtained by summing the populations recorded weekly in all localities and indicate the broad trend of events throughout the season. These curves are thus a summation of a number of individual and much less regular curves fluctuating about the general mean according to the condition of the plants on the individual beats. In this there is considerable variation, *H. calyphyllus*, for example, in very shady, cool situations fruits later than in more open, warm situations. Where conditions in any colony are stable or improving at the time of maturation of a generation, this tends to remain in situ and continue breeding. Where conditions are becoming less favourable the newly matured adults tend to disperse. In this way a continuous movement of adults, and in some cases of 5th instars, is in progress from one situation to another, which becomes intensified at such times as a whole group of hosts (e.g., *Abutilon* spp. in April) is drying up. It is believed that it is from the accumulation of such small dispersal flights, rather than from any mass movement, that the infestations of *D. nigrofasciatus* normally recorded as entering cotton are derived. This is supported by the well established fact that within the same year cotton crops are liable to become infested with immigrant stainers at any time from February to April according to their state of development.

The July–November Gap.—In considering the maintenance of the species from one season to the next the points of greatest interest are the fate of the adults produced in the June–July generation and the origin of those constituting the first immigrants to herbaceous hosts in late October–November.

It was suggested in last year's report that this gap might be spanned by a single generation maturing on *Dombeya rotundifolia*. This possibility is at present being intensively investigated: details of flowering, fruiting, general condition and stainer population are being taken weekly on 120 selected trees in four localities in the Barberton district and on a large number in five localities in Swaziland and the Pongola valley. As last year, only a small proportion of the trees under observation were infested by stainer, but on these immigration was spread over late July, August and into September, the population curve roughly following the flowering.

There was considerable variation in the time at which nymphs made their appearance following this initial infestation; in the most important locality in Swaziland early instars were abundant by the

end of September, but the number of 5th instars resulting from these was, under extremely dry conditions, very small. On several of the rounds nymphs failed to appear at all and on others did not appear until mid-October, being derived apparently from the tail end of the September immigration.

In general this year the development of the *Dombeya* generation has been just a trifle too late to account satisfactorily for the remarkable rise in adult population on herbaceous hosts noted in mid-November. Barely a fortnight is involved and it is possible that our sample trees may chance to be abnormally late, but the theory must remain for the moment not proven.

It is difficult, however, to see any other possible origin for the November flight; even if one postulates a dispersal to secluded shelters and flowering trees so wide and complete as to render the population practically invisible, the survival experiments (described below) do not suggest as possible a direct survival in sufficient numbers from July to November, whilst the most exhaustive searches for any other host at this time of year have revealed no alternative.

The above results all apply to *D. nigrofasciatus*. *D. intermedius* occurs, except on *Sterculia Rogersii*, in numbers insufficient for it to be possible to say anything other than that it appears to follow the same general course as the dominant species.

Records in Cotton.—For the first time since work on stainers has started it has been possible to observe the effects of a really wet season, with ample supplies of wild hosts, on the population of stainers fighting into well grown crops of cotton.

In most cases the initial immigrations of *D. nigrofasciatus* were quite small, of the order of 300–400 per acre peak population, coming about three weeks prior to boll opening, the start of which varied from early March to early April. *D. intermedius* was practically absent except in the immediate neighbourhood of *Sterculia* colonies. The initial infestations derived from wild hosts were thus amongst the smallest on record.

Peak populations bred in situ reached about 1,300 to 4,000 per acre, in most cases not until a month after the peak of the boll opening curve.

There were two exceptions to this state of affairs: on one farm in N. Swaziland infestations normally appear to be of a particularly high order and this was again the case this year, immigration being prolonged and reaching a peak population of over 2,000 per acre. This particular locality is, like the greater part of the Barberton valley, not in the immediate neighbourhood of perennial host plants, but unlike the latter place it is an almost isolated patch in the centre

of a large native area. It is believed that here the infestations may come from populations bred up on *H. Trionum* in native lands in the early summer, possibly also with some concentration effect. These points are at present being intensively studied by Mr. Hutchinson.

The second case of high initial infestation occurred on the early planted (October) plot of cotton put out by Mr. Bowmaker on the Pongola irrigation scheme. Early records were rather scanty here and one can only speculate as to the cause, but the cotton made enormous growth very early in the season and was in an extremely attractive state at the time of the maturation of the mid-January generation on wild hosts.

In general, however, there was a reassuring lack of any suggestion that a year of great abundance of host material necessarily leads to a correspondingly large infestation of cotton.

The Position of D. fasciatus.—This species continues to be distinguished by its practical absence on all wild hosts, except sporadically on *H. dongolensis* and *H. cannabinus* late in the season. Regular records have not up to the present been taken on wild cotton and *Cienfuegosia Hildebrandtii*, on which this species might, failing all else, be expected to occur, but from irregular personal examinations and reports from the recorders working on these points in connection with red bollworm, it is practically certain that these also do not carry the species.

Two cases of overwintering in cotton were kept under observation in the 1936–37 season. In both cases clear evidence of the survival of *D. fasciatus* from the previous season's crop was obtained and in both cases very large populations of this species were bred up in the ratooned (Barberton district) and standover crop (Magut district). In the Barberton case the field had a very poor stand and was much damaged by excessive rain and disease in February, so that the peak of the 5th instar population (23,000 per acre) was not reached until mid-May. Emigration was then observed to plant cotton on the same farm, but too late to damage the main crop. It was thus, unhappily, only possible to emphasize to the owner that his good fortune was most grossly undeserved.

The more usual course of events followed at Magut. Here the standover field under observation had produced a population per acre of 18,000 adults and 5th instar nymphs by mid-March, the population was rising steeply, the field was drying out and a general dispersal seemed to be in progress. Similar conditions were found on two other farms carrying ratooned cotton, and heavy immigrations were found to be in progress to neighbouring fields of plant cotton. The initial infestation of *D. fasciatus* on the Magut Cotton Station was at that

time 6,000 per acre, compared with 230 per acre *D. nigrofasciatus*, which might be regarded as the natural infestation the crop should have suffered. As it was, the effect of the immigrant *D. fasciatus* on this extremely healthy, well grown and heavily fruiting crop was disastrous.

The Stainer Marking Experiment.—The situation at Magut outlined above offered ideal facilities for testing the theory that infestations of *D. fasciatus* in plant cotton are derived from ratoon and standover crops, and for a fortnight Mr. Bowmaker carried out a large scale and most conclusive experiment on this point.

A total of 58,000 adult *D. fasciatus* were collected in the field of standover cotton referred to above, marked on the scutellum with blue cellulose paint and liberated at the point of collection. This occupied five days between the 22nd and 30th March. On the following day collections were started in the plant cotton on the Cotton Station, approximately $3\frac{1}{2}$ miles due West, and continued for a fortnight. During this time 83 marked stainers were re-collected. Similar collections were made in plant cotton at points $4\frac{3}{4}$ miles S.W., 5 miles N.E. and $9\frac{1}{2}$ miles W. of the point of liberation and in all cases marked stainers were recovered.

The wind throughout the experiment was light, varying from 1 to 3 on the Beaufort scale, and of variable direction. Specimens of *D. fasciatus* were observed in numbers in flight in the bush some distance from the standover field, and an isolated group of *H. dongolensis* halfway between the field and the Cotton Station received a sudden and transitory infestation of *D. fasciatus* at the same time.

Four very important points emerge from this experiment :

- (1) Plant cotton is definitely infested with *D. fasciatus* originating in standover cotton.
- (2) The range of flight of this species of stainer is at least $9\frac{1}{2}$ miles under almost windless conditions and a single breeding centre may thus infest an area of at least 290 square miles.
- (3) Adults are still alive and healthy, after travelling these distances, at least a fortnight and possibly three weeks after marking.
- (4) Dispersal from breeding grounds appears to be at random.

Following this year's experience with *D. fasciatus* strong representations have been made in support of the plea, fostered by local farmers, for legislation prohibiting ratooning and regulating the uprooting dates for plant cotton.

Survival Experiments.—Experiments were carried out in the dry season on adults and 5th instar nymphs collected in fields of standover cotton in July, August and September and kept under conditions approximating to those in the open, with the object of finding under

what conditions and to what extent the adult and late instar population present in the field at the close of the breeding season is capable of survival until fresh host material becomes available. Some of the results are recorded below.

1. Adults collected mid-July, kept at room temperatures averaging 4°F. higher than the mean in the screen*.

PERCENTAGE SURVIVAL ON DIFFERENT FOODS.

Weeks from capture.	<i>D. fasciatus.</i>		<i>D. nigrofasciatus.</i>	
	Water and dry seed cotton.	Water only.	Water and dry seed cotton.	Water only.
2	90	98	81	80
4	74	60	46	39
6	61	12	25	11
8	29	Nil	19	5
10	7	—	12	1
12	5	—	4	Nil
14	2	—	Nil	—
16	2	—	—	—
18	1**	—	—	—

2. Adults collected mid-August, kept in insectary, mean temperatures averaging 8°F. higher than in the screen.*

PERCENTAGE SURVIVAL ON DIFFERENT FOODS.

Weeks from capture.	<i>D. fasciatus.</i>			<i>D. nigrofasciatus.</i>			
	Water and dry seed cotton.	Water only.	Nil.	Water and dry seed cotton.	Water and artificial nectar†	Water only.	Nil.
1	85	89	1·2	58	47	35	Nil
2	62	33	Nil	48	42	7	—
4	51	4	—	12	26	1	—
6	42	Nil	—	5	12	1	—
8	18·5	—	—	2	4	Nil	—
10	11	—	—	2	2	—	—
12	5	—	—	2	2	—	—

3. Of batches of 5th instar nymphs collected in mid-August, 4·6% were surviving as adults after 12 weeks, in the case of *D. nigrofasciatus*, and 7·6% in the case of *D. fasciatus*, in both cases on water and seed cotton.
4. Of *D. fasciatus* adults collected in late September, 17·5% were surviving on water and seed cotton and 20% on artificial nectar by mid-November.

The results of these experiments, in the case of *D. nigrofasciatus*, do not encourage the theory that any large proportion of the adults

* The higher mean temperatures recorded in the laboratory and insectary are almost entirely due to the higher minimum temperatures: the maxima were 1° to 2° F. lower than in the screen.

** Representing a single male who, on the occasion of his conclusion of 18 weeks in captivity, was presented with a female with which he immediately mated.

† Prepared to a formula based on the analysis of cotton nectar made by Mr. F. S. Parsons (see forthcoming publication in Proc. Roy. Ent. Soc., Lond.).

constituting the first flight to herbaceous hosts in November is derived from the June–August generation. Since the November immigrant populations are usually of an order comparable with those of the peaks of the previous season, longevity in the field would have far to exceed that under insectary conditions, which seems unlikely on field evidence.

The figures do, however, lend colour to the theory that the immigration into *Dombeya rotundifolia* in July–September is derived from adults of the June–July generation and to the general idea that adults are enabled to survive in the late dry season on nectar, the figures for which are very striking, being actually slightly higher than those for seed cotton.

The results for *D. fasciatus* confirm the field evidence that in crops of standover cotton, or in fields where there has not been a proper clean up, this species is capable of overwintering in the adult state and that it is very much more resistant to dry season conditions than *D. nigrofasciatus*. The astonishing powers of survival of this species emphasize the necessity for adequate close-season measures.

The Climatic Factor.—A great deal of work has been done here and elsewhere on the food cycle of stainers, but in order fully to understand the causes of seasonal fluctuation in population the nature of the reactions of the stainer, in all its stages of development, to climatic factors, notably temperature and humidity, must be known. An attempt to discover the real conditions under which the stainers are living has been started this year at a point 20 miles from Barberton, where there is a fairly adequate and representative supply of host plants, as well as cultivated cotton.

The method briefly has been to suspend screened maximum and minimum thermometers and paper hygrometers within the body of clumps of herbaceous hosts or in the foliage of arboreal hosts and also to bury similar sets of instruments in the surface debris below these hosts. These instruments are read daily at dawn and at 3.0 p.m., maximum and minimum temperatures and maximum and minimum values for the relative humidity and saturation deficiency may thus either be observed or calculated. The eco-climates thus observed are compared with the standard climate as measured in the screen.

The work is still in its experimental stage; it has been done with a minimum of expense and extreme technical difficulties have been encountered. The results to date can only suggest general trends, but these suffice to shew that the work must be continued.

These investigations are being checked and such problems as they suggest are being studied by experiments on breeding under controlled conditions of temperature and humidity in the laboratory.

COTTON EXPERIMENT STATION, MAGUT, NATAL. PROGRESS REPORT FOR THE SEASON 1936-1937.

BY

P. A. BOWMAKER.

SEASON AND GENERAL.

The season under review gave a higher effective rainfall than any which has previously been reported, and almost double the average number of days on which a measurable quantity of rainfall was recorded over the cropping period November-May. The effect of the practically continuous rain in November was to make farming operations difficult and germination conditions uncertain, while later rains gave a heavy development of wood in cotton at the expense of fruiting. On the Station a heavy attack of American bollworm in early March caused severe loss in a good potential crop at a time when growth had become almost stationary owing to waterlogging. An influx of stainer, directly traced to early breeding in ratooned and standover cotton in the district, (dealt with more fully in the "Pests and Diseases" section of this Report), accounted for most of the balance of the crop, and trials were so obviously useless from a comparative point of view that no plot yields were taken.

The Station is comparatively close to a large area of cotton left as standover and ratooned in the season under review. On two outlying farms shown to be nearly out of range of pest migration from this area, and where conditions of waterlogging were not possible, yields of over 1,000 lbs. of seed cotton per acre were recorded. A large part of the land under cotton, however, came into the circle in which the "ratoon" influence was felt, and crops on the whole were very disappointing.

Against the set-back which this, combined with another period of low prices, has given in the district, may be set the interest which is being shown by the Union Department of Native Affairs in cotton as a cash crop for the non-European section of the Natal and Zululand population. A series of observation plots has been arranged for the 1937-38 season, ranging from Magut to Port Shepstone. A brief survey has been made of the botanical composition of the bush in the

coast belt, which lies outside the vegetation zone *known* to carry the natural food plants of red bollworm, and the native areas lying south of Eshowe show an almost complete lack of vectors. This fact, combined with the relatively high state of agricultural development which exists there at present, makes it possible that Natal may eventually produce cotton on a considerable scale.

COTTON.

Variety tests identical with those of previous years were attempted. Planting was carried out on 7th November. Germination from this planting was very irregular, the cause of this being the low soil temperature brought about by seven successive days of rain totalling over 6". A large amount of refilling had to be resorted to about three weeks later, which, in the early period of growth gave the trials a very patchy appearance. The effect of patchiness induced by refilling on the comparative value of yield figures, and the amount of refilling permissible is to be the subject of experiment.

Three weeks of dry weather followed the planting rains and good growth was made. Heavy and continuous rains in January and February stimulated the growth of wood to such an extent that strains normally presenting most opposite and characteristic styles of growth were not distinguishable. This levelling-up was completed by American bollworm in March, and stainer later. As plot yields following these conditions would have been valueless, no records were taken. A return of 202 lbs. of seed cotton per acre was reaped from the trials, compared with an average of 272 lbs. on the Station as a whole.

In accordance with the usual practice of the Station, seed multiplication blocks of all strains of about $\frac{1}{3}$ acre each were planted. Only a small quantity of seed of doubtful germinating capacity was harvested, and again a request has been made to Barberton for a supply of seed for the next season's work.

In the agronomic trials, as in the variety tests, no comparative yields were possible. A crop rotation experiment, a green manure trial and a spacing trial were planted.

For the 1937-38 season, when trials of the effect of previous cropping on cotton will be continued, fields were satisfactorily prepared.

ROTATION CROPS.

Owing to the nature of the rainfall little progress can be reported in the work of selection of drought-resistant types of maize from the variety American White Flint. A number of small bulks has been

made from the strains which appear to be useful from other points of view.

Mass selections, including the de-tasselling of undesirable types prior to flowering, are being continued from the varieties Anveld and Peruvian Red, these being considered the only other commercial varieties which are likely to respond to selection for drought resistance.

Two main planting dates were used, viz., 9th December and 23rd January, the yields averaging 1,160 lbs. per acre. Both plantings were affected by waterlogging, and the later planting suffered heavy losses from mice.

Tepary beans planted on 12th January gave a yield of 1,060 lbs. per acre. This low yield can be directly attributed to the heavy rainfall in February. Tepary continues to appear to be the leguminous crop most suited to low-velde conditions.

A variety test of groundnuts had to be abandoned owing to depredations of mice. Only sufficient seed was reaped from multiplication areas to supply Station planting requirements in the 1937-38 season.

Some excellent ensilage was made from Mapira (sorghum) planted in November and cut five months later. Mapira still seems to be the most suitable crop for ensilage purposes, a green weight of 26 tons to the acre being taken.

PESTS AND DISEASES.

As in previous years all pest infestation records have been sent to the Insect Pest Control Section at Barberton, by which the programme of work was arranged.

Pongola Valley.—In the previous Report it was stated that experiments in avoiding insect attack, by planting with the aid of irrigation out of the normal season for rain-grown crops, were to be initiated in the Pongola Valley. Two plantings were to be made on plots isolated from each other and from existing cultivation, in order that any insect damage noted could be attributed solely to influx from indigenous wild food plants. These plots, in extent about 6 acres each, will be dealt with separately.

Plot 1.—Owing to certain unforeseen practical difficulties it was not found possible to plant this plot until 16th October, about a month later than was intended. A slightly wider spacing than that commonly used on the Station was adopted to allow for the heavier growth that was likely to result on the deep alluvial soil on which the plot is situated.

The presence of Red bollworm was recorded from the beginning of December, and a moderately heavy infestation developed in the ensuing months. There was an early influx of *Dysdercus nigrofasciatus*, which may now be associated with the abundance of the wild food plants *Dombeya rotundifolia* and *Hibiscus* spp. (chiefly *calyphyllus*) found in the vicinity, which under the ideal breeding conditions found within the cotton crop produced a very large population. This, and to an even greater extent a severe attack of bacterial boll rot, accounted for a heavy loss of crop, particularly in the early and middle setting of bolls. It should be noted here that conditions for the multiplication of stainer and the spread of bacterial disease were due in part to the excessive and continuous rains. To avoid a carry-over of pests the bushes were cut out and burned before the crop was reaped, but it may be stated that, although such heavy stainer damage had been noted, an estimated crop of 1,200-1,400 lbs of seed-cotton per acre was being carried on the bushes which were destroyed.

Parsons has shown that Red bollworm moth activity ceases by the middle of April. Observations over a number of seasons on the Station have shown that the limiting factor to a continuation of cropping during the months April—July is usually moisture supply. In view of these facts, and for certain practical considerations, Plot 1 is to be planted at the end of January, thus avoiding heavy damage from Red bollworm and providing less suitable breeding conditions for the early influx of stainers. The cotton will be removed by September, a four-months' close-season thus being available at a time when the first multiplications of stainer and bollworm are normally in progress.

Plot 2.—This plot is situated on a medium red loam of good fertility. It is set in the midst of an abundance of *Fugosia* and *Gossypium* spp. and also large numbers of the various species of the wild food plants of stainers.

In the first instance it was decided that this plot should be planted as late as possible in the autumn, compatible with obtaining a fair germination, to avoid offering carry-over facilities for pests and at the same time to build a plant structure which would respond to watering in the early spring and bear fruit before the spring influx of pests had multiplied sufficiently to cause material damage in the crop.

Planting was carried out on 20th April, and a fair germination resulted. A profuse abortive flowering commenced in July on small bushes which had made no lateral development either of roots or sympodia. No fruit was set until mid-September, and the commencement of proper development of laterals was not evident until a month later.

The season's work has given an indication that the procedure must be altered with this plot also. An earlier planting (mid-March) is to be made with the object of obtaining a better plant structure which will be more likely to respond to watering in August. The pest position renders it necessary for the crop to be removed by the end of January, to avoid a heavy carry-over of Red bollworm and stainers.

General.—The plantings described above allow for two sets of conditions, the first in which the crop is carried right through to maturity without a break, the second which allows for a rest period of about six weeks in winter, the crop maturing in late spring and summer. Empirical planting dates have been formulated for these two main plantings, but to allow for the probability that a few days' difference in planting dates will make a large difference in plant behaviour a series of additional plantings on small plots is also to be made on various dates in February and March.

Station and General.—The disastrous attack of American bollworm on the Station in March has already been noted. This was attributed in part to infestation of moths from an earlier generation bred on chick pea, which had been planted especially as a trap crop. The chick pea was not able to exert its expected attractive power for this second generation, as growth and fruiting were at a standstill owing to the waterlogged conditions in February. There is a definite indication from this, that with the present knowledge concerning them, caution must accompany the use of trap crops.

Considerable numbers of Red bollworm were present in the crop from early in the season, but the damage caused by this species was completely overshadowed by the heavy attack of American bollworm.

The damage caused by stainer accounted for most of the balance of crop left by American bollworm. In the middle of March a visit to the Station by Pearson coincided with a heavy flighting-in of *Dysdercus fasciatus*. It was considered certain that these were coming from ratooned and standover cotton in the district, but as this still remained to be proved, an experiment was designed to throw light on the point.

Nearly 60,000 stainers were caught on a 110-acre block of standover cotton situated in the centre of the district, marked with a spot of Duco paint and liberated. Recoveries of marked stainers were made from plant cotton over a wide area. There is thus very definite proof that where ratooning is practised the facilities offered for the carry-over of stainers not only prejudices the chances of success of the farmer himself, but also those of his neighbours. Further details of this experiment are given in Pearson's report.

The results of this experiment are known locally, and strong support is to be given by farmers in the district to any proposal for legislation against the practice of ratooning.

A note on pests is not complete without a note on the plague of multimammate mice which became evident in the district in April. Heavy losses of lint occurred in the field, and in most instances an inferior grade was obtained owing to difficulty in ginning seed cotton in which only the holed husk was left attached to the lint. Severe losses from these mice also occurred in all other crops in the district.

SWAZILAND

COTTON EXPERIMENT STATIONS, BREMERSDORP AND CROYDON.

PROGRESS REPORT FOR THE SEASON 1936-37.

BY

J. V. LOCHRIE.

SEASON AND GENERAL.

Bremersdorp.—The season was marked by high but poorly distributed rainfall and was not a favourable one for cotton. Excellent early rains fell and, had the first planting in late October survived, a fair crop would have been reaped in spite of the later adverse factors. Unfortunately, the whole crop had to be re-planted owing to a heavy hailstorm in the end of November. The chief features of the season were—(a) good early rains, but abnormally low temperatures up to the end of November, (b) a very dry period of 5 weeks from early December, which retarded the growth of the re-planted cotton, (c) heavy rains during the next two months and excessive cloudiness in February which slowed up plant development, (d) a short season due to the early end of the rains in mid-March, the low temperatures prevailing from April onwards, and the prevalence of stainer-carried bollrots.

The cotton crop was planted in excellent conditions by the end of October and established itself well in the November rains. It was re-planted in late November following hailstorms and this date of planting is considered on the late side for this area. Climatic conditions which followed were unfavourable and the crop was slow in establishing itself. Good rains and rising temperatures during January improved the position and the crop made good progress. The heavy and almost continuous rains of February slowed up the crop, however, and caused a pronounced increase in infection of blackarm and angular leaf-spot. Conditions improved in March and the plants, though late and small, were fruiting well. The last effective rain fell on 16th March, and by the middle of April plants began to dry off on the shallower soil patches and flowering had ceased. The late bolls did not open and the average yield was only 500 lbs. of seed cotton per acre.

Damage by bollworm was slight, though a small amount of red bollworm was present all through the season. American bollworm threatened to become serious in early February, but the expected

heavy infestation of larvae did not materialize, owing, it is thought, to the high mortality in eggs and young larvae in the heavy rains. The losses by bollworm, though slight, were important on account of the poor recovery of the plants in the adverse climatic conditions.

There was some loss of crop by Blackarm and bacterial bollrot in the wet February, but the spread of the disease was checked by the dry weather which followed.

Croydon.—The climatic conditions were somewhat similar to those at Bremersdorp but temperatures were higher and the rains were better distributed and continued later in the season. As at Bremersdorp, hailstorms in late November made re-planting necessary. December rains were fairly satisfactory and, though the soil on this station is light and poor, the crop averaged 600 lbs. seed cotton per acre. In general, the crop carried on better than at Bremersdorp, due to the longer rainy season and to the higher temperatures.

Bollworm infestation was not heavy, but stainers bred up rapidly and the bulk of the later-formed bolls did not open.

SELECTION WORK AND STRAIN TRIALS.

The selections made from material supplied by Dr. Harland have been referred to in some detail in previous reports. The most promising were planted again this season, but owing to the short season, growth was small and the material has yet to be seen under conditions of big growth. The season did, however, show up some of the selections as being too late for this area. The most promising lots were from a (U.4 $\times$ Cambodia) $\times$ U.4 group and the best of these from the points of view of productiveness and lint and seed characters will be tested against U.4 strains in the coming season.

At both Stations a number of trials of strains from U.4 families were planted.

Bremersdorp.—The trials were re-planted at the end of November and at this Station such late planting means that for a good crop to be produced an extended growing season is needed. On account of the early finish of the rains, falling temperatures and the prevalence of bollrot in the later bolls, this was not experienced and the yield of 500 lbs. seed cotton per acre is a low level record for the Station. In spite of the poor yields, however, the trials afforded useful comparative data on strain performance. The features of the trials were—(1) the success of 052, a robust, early-maturing strain, which is now being distributed for general cultivation, (2) the good performance of the early strains generally, (3) of the later-maturing strains, those from the 921 family showed up well, while the 920 family and 0342 were

consistently lower yielding. These results follow in general trend the findings of the previous season's trials.

Croydon.—The trial at this Station was destroyed by hail and it was difficult to establish the crop in the later planting owing to damage by ants and grasshoppers. Stands were poor and the trial afforded no reliable information on the relative performance of the strains.

Manurial effect.—An experiment was laid out at Croydon to test the effect of applications of phosphate and kraal manure on the growth and yield of cotton. The Station is on light sandy soil and of fairly low fertility due to continuous cereal cropping by natives over a number of years. The treatments and rates of application per acre were, kraal manure alone (KM), 5,000 lbs. ; superphosphate alone (P), 200 lbs. ; the above two combined (KMP) ; and an unfertilized series (Nil). The treatment effects were marked throughout the season, the plots receiving kraal manure, either alone or with phosphate, making much better growth and development. Stainers bred up rapidly in the latter part of the season but, although migration took place to the kraal-manured plots where cover was best, these manured plots ripened a considerably increased crop. The features of the experiment were—(1) better growth and higher flowering on KM and KMP plots ; (2) KMP, KM and P yielded in that order and all gave significant increases in yield over Nil—the range being from 760 lbs. seed cotton per acre from KMP to 450 lbs. from Nil.

Green manure effect.—As in the previous season, an experiment was laid out to test the effects on cotton of various crops ploughed under as green manure. The crops ploughed down were cowpeas, soya beans and kaffir corn. These had been ploughed under in the previous summer and had rotted well before the cotton was planted. Yields were low, as on the rest of the Bremersdorp Station, and no significant differences in yield were obtained between any of the treatments. Cotton following soya beans yielded substantially less and this inferiority was borne out by the development records. Though the yield differences were not statistically significant the poor performance of cotton after soya is in line with information from experiments of the previous seasons.

Residual green manure effect.—Cotton was planted on the site on which maize following a range of green manure crops had been grown in the previous season. The crops ploughed under were sunnhemp, cowpeas, soya, kaffir corn and bulrush millet. Growth and flowering was very even over the area of the experiment and there were no significant differences in yield between any of the treatments.

ROTATION CROPS.

The season was more favourable for crops other than cotton, the cereals yielding satisfactorily in spite of the prolonged dry spell through December and early January.

Kaffir corn.—Selection work was continued on the early-maturing dwarf strains which are now being distributed to replace the taller and later varieties in general cultivation. The original strains of dwarf type bulked for distribution were white-seeded and in some areas there is a prejudice amongst natives in favour of red-seeded kaffir corn. As a result selection work has been continued on material from crosses between the dwarf whites and a taller and later native red. Some of the progeny of these crosses such as 70/0, 74T and others have shown up promisingly in yield and are red-seeded, early and of dwarf habit. A number of these new strains have been planted in observation plots through the country and appear to be as satisfactory agriculturally as the short whites.

Trials of a large number of strains were conducted at both Stations.

The trials at Bremersdorp, which included two reputedly outstanding local varieties, were planted towards the end of November. Conditions were fairly good during the season, though growth was held up in the dry December. The features of the trials were: (1) the good cropping of the early short whites such as 44, 2 and 41, (2) the poor performance of the two local varieties which averaged 750 lbs. per acre against 2,000 lbs. for the short whites, (3) the success of the newer short red strains such as 74T and 70/0, which equalled the yields of the short white strains.

The results at Croydon, with its better December rains and longer season, corroborated those obtained at Bremersdorp. The season favoured the taller and later local varieties, but even under these conditions the short white and red strains gave the highest yields.

Maize.—Selection work and comparative trials of strains of White Flint maize were carried out. Though the crop had poor early conditions in December, the satisfactory average yield of 2,500 lbs. per acre was obtained. In addition to the medium early main crop strains, a few very early maturing selections have been under observation on account of their suitability for very delayed planting or for early planting to get a quick crop. In the trials at Bremersdorp and at Croydon these early types again showed up poorly in yield and in their tendency to lodge. Selection has shown no improvement in these directions and the very early material can be discarded.

Fertilizer effect—Bremersdorp.—The permanent layout described in previous reports was planted to maize this season. The rotation is two

course—cotton and maize—and the annual treatments and rates of application are kraal manure, 5,000 lbs. per acre (KM) ; kraal manure plus superphosphate, 200 lbs. (KMP) ; superphosphate alone, 200 lbs. (P) ; muriate of potash, 200 lbs. (K) ; the latter two treatments together (PK), and an unfertilized series (Nil). The crop was planted early and had good conditions. The yields averaged 2,700 lbs. per acre and ranged from 3,300 lbs. for KMP to 2,000 lbs. for Nil and 1,800 lbs. for K. The experiment showed—(1) the beneficial effect on growth and yield of these comparatively small applications of kraal manure, (2) no significant yield differences between KMP, KM and P, but all three significantly higher than PK, Nil and K, (3) depressing effect of potash on the maize yields.

The beneficial effects of kraal manure and of phosphate corroborate the results previously obtained with maize and cotton at both Stations. The effect of potash at Bremersdorp during the course of the experiment is interesting. In the first and third seasons of the experiment the land was under cotton and increases in yield were obtained from applications of potash, whether applied alone or with phosphates. In the second and fourth years the land was under maize, and applications of potash had a depressing effect on yield.

Green manure effect.—A similar experiment to that described under cotton was carried out with maize—the crops ploughed under being kaffir corn, cowpeas and soya beans. The yields from all treatments showed no significant differences, though maize following soya was easily the lowest. The witchweed parasite of maize has been controlled to a great extent on this area, but counts of parasites in the present experiment showed a further decrease on all plots following kaffir corn.

Residual green manure effect.—Maize was planted on the site where cotton following a range of green manure crops had been grown in the previous season. The green manure crops were sunnhemp, cowpeas, soya, kaffir corn and bulrush millet. The experiment showed no significant yield differences between treatments.

The objects of the experiments during the past seasons were (a) to make comparative tests of various legumes as green manures, (b) to ascertain if a crop such as kaffir corn could be usefully substituted for a legume to combine witchweed control and value as green manure.

The results obtained in tests with cotton and maize during the past years indicate that (1) soya are the least satisfactory green manure or rotation crop for cotton and to a lesser degree for maize, (2) in general sunnhemp has given the best results with both crops, (3) kaffir corn, provided that ploughing under is done sufficiently early, is a satisfactory

green manure, more particularly when followed by cotton. In the course of the tests the only treatment to have shown up better from the point of view of yield has been sunnhemp, and in areas where witchweed is prevalent, kaffir corn may be substituted with advantage for a leguminous green manure crop.

Groundnuts.—Comparative trials of strains of groundnuts were continued at Bremersdorp and Croydon. At Bremersdorp early conditions were good but yields were lessened by the dry latter part of the season and the packing of the soil by the heavy February rains. At Croydon conditions were better and good yields up to 2,200 lbs. per acre were obtained. Strain Br. 2 again showed up well and this strain and its re-selections gave the highest yields.

SOUTHERN RHODESIA
COTTON-BREEDING STATION, GATOOMA.
PROGRESS REPORT FOR THE SEASON 1936-37.

BY
 J. E. PEAT AND A. H. MCKINSTRY.

GENERAL.

In last year's Progress Report, 1935-36 was reported as providing "the worst conditions so far experienced for the start of a season": it was a poor year for cotton. In contrast 1936-37 has provided the best conditions since the Station started, twelve years ago. Early planting rains and favourable growing conditions until February gave the young crop a very favourable start. In spite of a drought in the latter part of February which lasted through March, yields were good.

On the Station, the bulk lots, more or less under commercial conditions, averaged around 1,000 lbs. seed cotton to the acre. Smaller areas of some strains, and areas under special treatment, were yielding slightly more.

Although the production of the country is still very small, yields on the whole have been satisfactory, and where crops have not been up to standard, in many instances the fault was due to the grower, and partly preventable—poor stands, poor land, and stainer damage from ratooned cotton in the area. The percentage of stained cotton was high.

An Act—The Cotton Pest Prevention Act—has been passed through the Rhodesian Parliament, enforcing a close period, prohibiting ratooning and the leaving of cotton crops "stand-over."

On the Station one of the most striking features has been the increased yields due to applications of Indore compost. Another interesting feature has been the high attractiveness of Dolichos beans to American Bollworm egg-laying.

Native production is still in its very early stages, but many of the yields obtained this season on half-acre and one-acre plots have been good. It is probable, however, that the native mentality will preclude anything but a slow expansion of the native cotton-growing industry.

SEASON.

The rainfall, on the Station, was 27·28". Planting rains fell just before the middle of November, and the crop got a very good early start. Stands were excellent. Growing conditions were almost ideal until the end of February, when a drought period of nearly five weeks from the third week in February caused loss, especially where cotton was growing on land not in good heart. In addition, this period of drought is probably partly responsible for the high proportion of fairly short stapled cotton ginned.

While the drought period was more or less general in the cotton-growing areas, local showers eased the position for some growers, and even for some parts of one farm. The crop ripened for one early picking, and therefore the winter temperatures did not affect the crop position.

BREEDING WORK.

Again, as in the past few years, the sub-strains of U.4/64 (G.5) were markedly outstanding. The position has now been reached where, with the exception of the cross material and a few type strains, only derivatives of U.4/64 are being handled in the primary selection work. The two strains grown throughout the country—U.4/64/7/10/1/No. 2 (G.5,123), and U.4/64/7/10/No. 6 (G.5,79)—yielded well. On the Station under bulk conditions, they were yielding around 1,000 lbs. seed cotton to the acre. In a strain trial there was no significant difference between them. G.5,123 is more open in habit than G.5,79, but the latter has slightly better lint qualities.

A considerable number of fresh selections have been made within the sub-strains, mainly with a view to increased jassid resistance. There was a heavy culling of the less resistant and less satisfactory strains. A standard of hairiness, more or less arbitrary, was set and nothing less hairy than this was retained. From this more jassid-resistant material it is hoped that a strain will be developed to replace G.5,123 and G.5,79, probably much the same in fruiting habit and earliness, but with slightly higher degree of jassid resistance, and slightly better lint and ginning qualities.

In addition to the run of selections from the U.4/64/7 stock, there are some interesting lots from a U.4/64 sub-strain, G.5,136, which has a comparatively high degree of jassid resistance, good fruiting qualities, and better lint than the majority of the U.4/64 derivatives.

It might be mentioned that all ginning for the country is now performed at the ginnery at Bindura under the control of the Cotton Research and Industry Board. There is thus control of all seed issued. Seed intended for planting is tested for soundness, and only seed above about 60% sound is sold as seed.

A number of strains, including some of the Barberton material, promised very well almost up to the time of boll opening, but they failed to finish their crop, and opened badly. They appeared to suffer from considerably more staining than some of the neighbouring lots. As a type, the plants are heavy fruiting and heavily leafed. Some of them in February-March, in the row, looked almost hedge-like in habit. The inner bolls, and it is they which suffer most, must get much less light and be developing under much more humid conditions than the comparable bolls in the more open types. It is difficult to say whether the bad finishing and bad boll-opening are primarily due to the style of plant, or whether it is the plant habit that permits either increased stainer attack, or easier spread of Internal Boll Disease. This coming season plantings of this type of growth will be made to record stainer populations and the degree of staining.

The small bulks and selections from the survivors of Harland's U.4×Cambodia backcrosses, mainly from A.F.C.6, A.F.C.15, and A.F.C.26, yielded and opened well. Before reaping they made a spectacular showing. Their ginning percentages and seed weights are high; but the lint is somewhat short and harsh. Within the bulks there is still a considerable amount of segregation, but the best of the lots are well worth continuing.

As has been mentioned in previous reports, for the last three years there has been a considerable Station programme of crossing, using the best available Cambodia parents for hairiness, and the pick of the U.4 strains. Further backcrosses were made this past season. There is very promising material within these lots, and it is probable that it will be a strain from this material which will replace ultimately the best of the U.4/64 derivatives.

CULTURAL WORK.

Spacing trials were again carried out. As in the past years, fairly close spacing gave the best results, around 6"-12" in the row.

With the good conditions of the season, flowering was heavy. At the ordinary commercial spacing, of 6"-12" in the row, it reached 1.8 flowers per foot of the row per day in the third week of February. The development records show that loss by shedding was light until the end of February, and that the March shedding was predominantly

not due to bollworm. Thus the American bollworm attack in March probably had little effect on the size of the crop ripened.

The Indore compost, mentioned in last year's Report, was applied to bulks and single plant lots. The results have been very good. Just over 60 acres have been composted ready for this coming season, and a trial has been laid down with various rates of application. If the results this season come up to expectation, there will have to be some change in the economy of the Station, in the way of more feeding of cattle to obtain the necessary quantities of dung. Sunnhemp and *Dolichos* bean hay are being used, and wintersome and maize ensilage.

The composted areas came through the drought period much more happily than the adjoining non-composted area in the same field. The bulk adjoining the compost strips gave an average yield of about 500 lbs. seed cotton per acre; the strips dressed with 5 tons per acre compost averaging around 900 lbs., and those dressed with 10 tons to the acre just over 1,000 lbs.: while the strip with the heaviest dressing—20 tons to the acre—gave close on 1,300 lbs. seed cotton per acre.

It must be mentioned, however, that the replication of the bulk strains on another portion of the Station, on friable red land in good heart, but not composted, averaged around 1,000 lbs. seed cotton to the acre. But this area had a good local shower about half way through the drought period.

The benefits of growing cotton in a rotation are illustrated by this year's maize yields. On the two main lands which were under cotton in 1935-36, a total of 66 acres, the average maize yield this season was 18 bags (of 205 lbs.) per acre, without dung, compost or direct fertilising.

INSECT WORK.

Jassid.—It has been a year of very mild jassid attack, especially contrasted with last year, when in some areas in the country a few crops suffered quite seriously. This year at Gatooma, even Improved Bancroft, a highly susceptible variety, was only lightly attacked, and produced a fair crop. (Last year the Bancroft plot, in spite of a fair stand, eventually yielded at the rate of 4 lbs. of seed cotton per acre.)

As has been discussed earlier in the Report, the main aim of the present selection and breeding work is to get material retaining the heavy yielding and good opening qualities of the strains in general cultivation, but with increased jassid resistance.

American Bollworm.—In most years American bollworm attack is the most important single factor affecting the crop. But this past season it has been comparatively unimportant, and secondary to two other factors—Stainer damage, and the February-March period of drought.

On the Station, as a result of the favourable early season, the plants had set a considerable crop of bolls before the sharp rise of American bollworm egg-laying at the end of February, and it is probable from the records that most of the portion of the crop taken by American bollworm would have been lost anyway towards the end of the drought period, bearing in mind that the plants were already maturing a heavy crop of bolls.

Egg-laying on cotton started in mid-January, roughly at the commencement of flowering, but it remained comparatively light until the end of the third week in February—averaging on one land an estimated figure of 3,000 eggs per acre per day (based on counts on scattered single plants throughout the crop). On this land it reached a peak just before the middle of March, of about 30,000 eggs per acre per day. Egg-laying on cotton was over by the end of the third week in March.

The different plantings of maize were attractive from the second half of January through February, with maximum egg-laying of about 1,000 eggs per acre per day, though the heavy rains in early February may have washed off numbers of eggs from the maize plants, thus upsetting accurate record taking. The main plantings had ceased to be attractive by mid-February—too early to be of much help to cotton. By the end of February all the maize had passed the attractive stage. Egg-counts were also taken on areas of wintersome, Rhodesian Sudan grass, Kaffir corn, velvet beans and grams.

But, as last year, the striking records came from two areas of *Dolichos* beans. The first records of egg-laying on the beans were in mid-January, *about two months before they came into flower*. (They had been planted in the third week in November.) The egg-laying started to rise early in February; by the end of February, when the egg-laying on one cotton land was about 8,000 eggs per acre per day, the egg-laying on an acre of *Dolichos* beans in the adjoining land had risen to around 30,000 eggs per acre per day. The peak of the egg-laying on the cotton land, just before the middle of March, was approximately 30,000 eggs per acre per day, whereas on the *Dolichos* at the same time the peak reached about 200,000 eggs per acre per day. Moreover, during March there had been considerable flowering loss owing to *Dolichos* buds and flowers having been eaten by C.M.R. type beetles.

The beans were recorded as showing flower buds in the second week in March. They remained attractive until the end of May. An interesting point is the heavy egg-laying that took place long before flowering had commenced.

This marked attractiveness of *Dolichos* is the most important feature of the American bollworm work of the year. In Rhodesia we have never found the marked attractiveness of maize relative to cotton experienced round Barberton, nor have any of the other crops grown been at all markedly more attractive than cotton.

This coming year the main experiments on egg-laying attraction will be with *Dolichos*. One area has been ratooned to give earlier flowering; and from the Sudan a small quantity of the early flowering Poona lubia has been received. Although planted this year immediately after cotton, the *Dolichos* strain grown did not come into flower, and into full attractiveness, until nearly mid-March—considerably later than is desired. During the past four seasons, using the same strain throughout, there has been a considerable variation in the time taken from planting to flowering—a range of from just over 50 days, to over 100 days this season. *Dolichos* planted in February takes a much shorter time to reach the flowering stage than when planted in November–December.

Fifth and sixth instar American bollworm larvæ were introduced into field cages from the beginning of March, until the middle of April. They were allowed to go down and pupate. Emergence records are not yet complete, but the first introductions emerged from the third week in March. There were emergences until the middle of May from the later introductions, but no emergences during the cold weather. There have been only five emergences to date since the rise in temperatures.

Sudan Bollworm.—Just over 6,000 4th and 5th instar Sudan bollworm larvæ were again put out in field cages during April and May, 1936, and allowed to pupate. Just over 2,000 normal moths emerged. There was a fair emergence in the second half of November, with the main emergence occurring in December and tailing off somewhat in January. Moths were, however, still emerging from the cages throughout February and into March. The emergence records are much the same as those for 1934–35.

In last year's Report it was mentioned that legislation was being sought to prevent ratooning or the leaving of cotton stand-over. During the season a "Cotton Pest Prevention Act" was passed through the Rhodesian Parliament, prohibiting ratooning and the leaving of cotton "stand-over." This year October 1st was fixed

as the date by which all growing cotton must have been destroyed. It is considered most probable that the enforcement of this measure will not only prevent the spread of Sudan bollworm, but in most areas will reduce it to the position of a minor pest.

Stainers.—The season has been a bad one for stainer damage. This is reflected in the ginnery figures, where the amount of “good colour” cotton was only 32% as against 56% last year. A large proportion of the 25,253 lbs. of native seed cotton handled was spotted.

There are, however, two points which must be borne in mind. The native growers are new to the crop, and tended to mix stained and clean cotton in the one picking. With a certain amount of grading in picking, a higher proportion of the native cotton would have been “good colour.” As regards the European crop, one or two of the biggest growers suffered badly from stainer damage, owing to ratooned or stand-over crops in their vicinity.

Undoubtedly this year some very promising crops were seriously reduced as a result of stainers moving into them from ratooned or stand-over crops in the area. Probably the most important immediate effect of the Cotton Pest Prevention Act will be the prevention of this part of stainer attack. But in addition to this, stainer damage throughout the country has been high this season.

At Gatooma, populations in February–March were ranging around 1,000 adults per acre, with *D. intermedius* the predominant species. From the end of March there was a relatively large increase in *D. fasciatus*. Total populations in April moved up to about 5,000 adults per acre. *D. supersticiosus* was present in small numbers.

On the Station the greater part of the cotton picked was “good colour,” and on the whole the actual stainer damage was light. It may be that the dry period in February–March was responsible for this. In addition, the fact that the crop was made early prevented the later increase in population from affecting it seriously.

The staining and the bad opening amongst certain strain types have been referred to earlier in this Report.

For a period of about ten days from mid-February, up to 300 stainers per acre were caught on cotton seed traps, when the population present in the field at the time was well under 1,000 adults per acre. With the prolongation of the dry period, the traps ceased to be attractive. Nymphs were also attracted in fair numbers to these February cotton seed traps. Experiments with fresh traps in a previously untrapped area showed that nymphs from throughout the field were being attracted to the traps.

INVESTIGATIONS AT THE SABI TANGANDA ESTATE.

At the time of writing, the full results are not available, but the records so far received support those previously obtained, and suggest that a crop of sorts can be obtained by planting at the end of February or early in March.

The crop was planted at the beginning of March and got a very good early start; the stand was good. Sudan bollworm egg-laying was negligible. During June there was a moderate stainer population—around 2,500 adults to the acre, mainly *D. fasciatus*. But by the end of June only very occasional stainers were found. The population started to rise again in October. Stainer damage was light up to November but a high proportion of the young October bolls then showed staining. The low temperatures in July checked the crop, and during that period it suffered from aphid attack.

A fair crop of moderate cotton was reaped. There seems now to be no doubt that by planting about the end of February, or early March, a crop can be grown which will dodge serious stainer and Sudan bollworm attack. But it is doubtful whether the winter minimum temperatures will allow of a sufficiently good crop being reaped to be commercially profitable, having regard to the fact that the crop has to be grown under irrigation.

NORTHERN RHODESIA.
RESEARCH STATION, MAZABUKA.
PROGRESS REPORT ON THE COTTON WORK,
SEASON 1936-37.

BY

A. G. BEBBINGTON (*Empire Cotton Growing Corporation*) AND W. ALLAN
(*Northern Rhodesia Department of Agriculture*).

The rains were early as compared with the previous season, but very light, and planting was delayed. Good rains fell in January and February and the flowering rate was higher than ever recorded before at Mazabuka. Little damage was caused by American bollworm, but the attack of *Dysdercus supersticiosus* was very heavy in the earliest planted cotton, while that of *Dysdercus fasciatus* was very much earlier and of greater intensity than in the previous season.

COTTON EXPERIMENTS.

Observation and bulk plots were planted at Mazabuka, together with a number of (U.4×Cambodia)×U.4 crosses. It has now been decided to discontinue all cotton-growing on the Station at Mazabuka with the exception of a two-acre bulk plot to be used for stainer records.

INSECT WORK.

Bollworm.—The attack of American bollworm (*Heliothis obsoleta*) was very light during the season, and little or no damage was done to the crop. Egg counts were carried out on seven plantings of maize, sorghum, groundnuts, native beans and cotton. The counts on maize and cotton were duplicated on a neighbouring farm and counts were also made on sunflowers. The results agreed with those of previous seasons in showing that maize exhibits the greatest attraction to the moth. The layings on groundnuts and native beans proved to be negligible, those on sunflower, however, were considerably higher than the corresponding layings on cotton.

Stainers.—In order that the present trend of the work may be more readily understood it may be well to give a brief recapitulation of the situation. The area in which cotton trials and stainer records

have been carried out during the last three years is some hundred and fifty miles in length and one hundred miles in width, in the centre of which lies the extensive grassland of the Kafue Flats. Bordering the alluvium of the flats is a rim of fertile colluvial soil—the “Acacia savannah”—which passes into a belt of variable transitional soils. These types are succeeded to North and South by the poorer sandy soils of the plateau. There are therefore seven major soil belts to north and south of the area.

1. The Northern plateau, weak sandy soils under *Isobertlinia-Brachystegia* woodland.
2. The transitional soils, an exceedingly variable group.
3. The Northern Acacia savannah belt.
4. The alluvial grassland of the Kafue Flats.
5. The Southern Acacia savannah belt which comprises the Mazabuka farming district.
6. The Southern transitional type varying from good loams to poor sands.
7. The Southern plateau soils similar to those of the Northern plateau.

Within this area and more particularly within the Acacia savannah belt the main obstacle to cotton cultivation is heavy stainer attack, the two species concerned being *Dysdercus supersticiosus* and *Dysdercus fasciatus*.

D. Supersticiosus.—Our records show that a large parent population (the origin of which is not so far clearly understood) appears in the Northern and Southern plateaux in September and an F_1 generation of enormous size is bred up on a species of *Triumfetta* which grows abundantly in the stream valleys. The growth of the *Triumfetta* is dependent on burning and we have found that when stream valleys are protected from grass fires the plant fails to appear except in negligible quantities. This F_1 generation migrates with the first rains in November and a very large wandering population appears in the Southern Acacia savannah. This sequence of events has now been recorded in three seasons and last season an attempt was made to obtain a better picture of the migration by large-scale random field collections. In the past the migration of the F_1 generation has been followed by breeding on *Hibiscus trionum* around the edges of the Kafue Flats and this resulted in an F_2 generation which reached its maximum in February. When this F_2 generation was large it virtually destroyed the early crop on the experimental plot at Mazabuka.

During the last three years however, *H. trionum* has tended to disappear from its old sites within the recording area at Mazabuka.

There can be little doubt that this disappearance is due to the removal of the native population once settled along the edge of the flats. Constant grazing and trampling by large herds of cattle kept the grass short and enabled *H. trionum* to flourish. Now the long grass has come back and has swamped the *Hibiscus*. In the present season there was practically no *H. trionum* left and this has had a very marked effect on the attack of *D. superstitiosus* on cotton. The F_2 generation was bred up on the fallen seeds of *H. asper* and it matured much earlier than would have been the case on *H. trionum*. Furthermore, breeding extended only over a short period owing partly to the rotting and partly to the germination of these seeds. Thus, early in January there was a fairly large population of *D. superstitiosus* adults of the F_2 generation in the field, but as it was not maintained by breeding it decreased rapidly in number. Consequently the earliest flowering cotton suffered more severely from this stainer and progressively slighter damage was done to the later plantings. We have pointed out in past reports that in the soil and vegetation belts outside the Acacia savannah the attack of *D. superstitiosus* is not of much importance since it is diverted from cotton by early flowering hosts. Within the Acacia savannah belt the *H. asper* complex—really a gradation of hybrids of *H. asper* and *H. cannabinus*—begins flowering late in March. In the transitional and plateau belts *H. asper*—apparently a purer type—flowers early in February.

D. fasciatus.—The most interesting feature of this season is the attack of this species on cotton and the part played in it by the early flowering *H. asper*. The chief host of the species is *Thespesia rogersii*, a small tree abundant in the Acacia savannah, less common in the transitional soils and sparsely scattered over the plateaux types. The attack of *D. fasciatus* on cotton, as we have shown, is greatly affected by the flowering and fruiting of *T. rogersii*. A year of early and abundant flowering is one of late attack and therefore of little importance, while, conversely, if flowering is small and late, an early and serious attack is to be expected. Again one would expect in each year that the attack of *D. fasciatus* would be heaviest in the Acacia savannah and lightest in the plateaux, and our records show this to be the case. The season was one of exceptionally low and late flowering of *Thespesia* throughout the whole area, as compared with the previous season when flowering was early and abundant. Thus in the present season the surviving population of *D. fasciatus* was early driven from the trees. In the transitional and plateau areas this population bred up on early flowering *H. asper*, a development which we have not previously recorded. Thus a very great population which migrated

to cotton was bred up in these areas. Even more remarkable, however, was the effect of the attack on the plants in different districts. On the transitional soils of the Southern belt the crop on the 100 plots scattered through the area was virtually destroyed, the highest yield being 91 lbs. of seed cotton per acre and the average 24 lbs. Strikingly different were the soils of the Northern plateau which gave satisfactory and very uniform yields the highest being 340 lbs. and the mean 224 lbs. of seed cotton per acre (planted before December 15th), the mean for all plots including late plantings being 193 lbs. The plots on the Northern transitional soil gave very variable yields, as might be expected, the highest being 668 lbs. per acre and the mean 226 lbs. per acre (planted before December 9th). The mean for all plots including late plantings was 174 lbs. of seed cotton per acre. There were few results from the Southern plateau owing to the opposition of the local Chief to cotton-growing, but two Mission plots grown on this type gave 580 lbs. and 490 lbs. of seed cotton per acre.

There seems to be little doubt of the reason for these differences. On one type of soil the plants are definitely earlier and set their crop much more quickly. The stainer attack over all was strictly comparable where both the factors of time and intensity were concerned. Thus population records alone are of no value, but must be correlated with plant development records on various soil types. The solution of the problem would appear to lie in (a) early planting, (b) the use of strains which are capable of producing a large flush of flowering on poor soils, in order to evade the early part of the attack and to reduce the stainer/boll ratio. Two sub-stations have been established in the Northern and Southern transitional soil types and trials of various strains will be carried out there.

Mr. R. H. Fraser of the Department of Agriculture established preliminary trial plots in the Luangwa Valley during the season. These gave very promising results, particularly in view of the fact that the crop was quite new to the natives concerned. The average yield over 20 plots, each of half an acre, was 385 lbs. of seed cotton per acre. A preliminary survey of one part of this valley has been carried out to determine the distribution of stainer hosts. As this was made in September, little could be learned of the herbaceous hosts, but the presence of the following was determined; *Hibiscus esculentus*, *H. asper* or *cannabinus*? and *H. vitifolius*. Among tree hosts, *Sterculia triphaca*, *Andansonia digitata* and *Thespesia rogersii* occur in quantity in the valley proper, while *S. quinqueloba* (a host of *D. intermedius*) occurs in the foothills.

A similar survey of a portion of the Zambesi Valley was also carried out. The two valleys are very similar in their vegetational characteristics and the same stainer hosts were established as being present. Arrangements have been made for a series of trial plots in this area in the coming season.

In the insectory the study of the effect of food, temperature and humidity variations on the rate of development of *D. supersticiosus* has been continued and has furnished some very interesting results, which need further investigation.

ANGLO-EGYPTIAN SUDAN.

PROGRESS REPORT ON THE WORK ON COTTON CARRIED OUT BY THE PLANT BREEDING SECTION, AGRICULTURAL RESEARCH SERVICE, SEASON 1936-37.

BY

TREVOR TROUGHT.

The following report has been compiled from reports written by Mr. H. E. King (*Sudan Government Plant Breeder*), Mr. R. R. Anson and Mr. R. L. Knight (*Empire Cotton Growing Corporation's Plant Breeders*).

GENERAL.

The season was satisfactory, and good yields were obtained in the Gezira, Shambat and the Nuba Mountains. Varietal tests in Dongola District and the Equatorial Province also were successful. At Kadugli the permanent layout of the Farm has been completed, and there are seven feddans* for the breeding plots, and nine feddans worked in rotations of three feddan blocks for varietal testing of cottons, duras and legumes.

CLIMATE.

The Gezira.—The Research Farm had a heavy August rainfall, and a hot dry spell from mid April to mid June. The average maximum temperature for May (109° F.) was the highest on record. There were cool spells in December, January and March. The rainfall was normal in the south and centre of the Gezira as a whole and rather lighter in the north.

Shambat.—Maximum temperatures were above average during May, June and parts of July, and also in October, November and early December. From mid December to late January there was a cool spell, but high temperatures occurred later. Rainfall was a little below the average, the total of 139 mms. including an unusual fall of 15 mms. in April (1937).

* 1 feddan = 1.038 acre = 4,200 sq. metres.

Kadugli.—The rainfall (900.5 mms.) was slightly above average. The effective planting rains were a little late and rain ceased abruptly by the end of October. Temperature during the day remained at about 90° F. until the end of December.

DISEASES AND PESTS.

The Gezira.—Outbreaks of blackarm were recorded generally over the Gezira, but the incidence was not severe in general.

Leaf curl development was slow on Sakel, and practically non-existent on X.1530.

Pink bollworm was moderately severe, but Egyptian and Sudan bollworms did little damage.

Shambat.—Blackarm occurred, possibly as a result of the earlier sowing date used in the hope of avoiding pink bollworm. Pink bollworm was actually less than in recent years, but the cold spell in December and January may have contributed to this effect. It was troublesome in late sown breeding plots.

Kadugli.—Blackarm did some damage and white ants, leaf roller (*Sylepta derogata*), flea beetle, Sudan and Egyptian bollworms were the major pests.

EXPERIMENTAL RESULTS.

Cotton Breeding. Work—Egyptian Strains.—Steady progress has been maintained on the lines indicated in last year's report. The NT.2 (ex Gash Sakel) strains maintained their promise, but the very low leaf-curl infection at the Gezira Research Farm made selection work more difficult.

Hybrid types gave few families of real promise, compared with the types obtained by "straight selection."

The breeding work on blackarm resistance (at Shambat) was carried a stage further and 1,156 plants of the first backcross ($X.1530 \times \text{Uganda B.31}$) $\times$ X.1530 were raised. The vegetative appearance of these plants was much nearer X.1530 than B.31. These were sprayed with a blackarm suspension twice a day for three days. An examination made ten days later showed that the fully susceptible plants were well defined and could not have been confused with even the least resistant of the others. There were 277 susceptible plants and 879 plants showed different degrees of resistance. Heavy roguing to the required vegetative type left three plants which were used for further backcrossing, and also crossing with the NT.2 type to try and add improved lint quality.

In the backcross (X.1530 $\times$ B.31) $\times$ NT.2 similar results were obtained, and five resistant plants selected for the nearest approach to Sakel habit were crossed back to NT.2 again.

American Breeding Work (at Kadugli).—Fifty families were grown. White ants attacked the seedlings and affected the stand, and blackarm badly infected Columbia strains and some local selections. Some of the "Harland Hybrids" selections also showed susceptibility to blackarm, but some were resistant. Resistance unfortunately seemed correlated with late maturation and weak lint.

Altogether nine families were bulked for Line Testing.

In addition, single plant selections from an inspection plot of Durango were made. This plot, though mixed, possessed some very attractive looking plants, but showed little resistance to blackarm.

Propagation of Egyptian and American Strains.—The usual propagation of new types to provide sufficient seed for large-scale testing was carried out at Shambat. A propagation plot of XA.129 was also grown at Nuri.

VARIETAL TRIALS.

(a) *Egyptian Varieties.*—The "Line Test" at the Gezira Research Farm grew well.

The layout varied from that used in previous years, as the lines were divided up into four shorter lengths and sown in separate randomized blocks. The yields were then analysed by the "analysis of variance" method. NT.2/36, NT.17 (an X.1530A re-selection) NT.35 (a selection from the original L.B.A.R. stock), NT. 18 and NT.36 (both re-selections from XO.4729) all did well.

Standard tests were grown on the Research Farm and Barakat Seed Farm, and comparative inspection plots were laid out as replicated tests this season at Hag Abdulla and Umm Degarsi, with one of normal layout at Wad Shair.

The varietal test on the Research Farm suffered from flooding caused by heavy rain, and many seedlings were killed. Blackarm infection also was considerable, though no clear varietal differences were distinguishable.

NT.2, NT.19 (an XO4729 substrain) and NT.16 (a Lecrem re-selection) did well, but re-selections from X.1730A were no better than X.1730A itself. The early maturity shown by NT.3 last season did not show up this season.

At Barakat the experiment grew well and there were no irregularities likely to vitiate the comparison between strains. NT.3 was a comparative failure and NT.2/34 gave a high yield, its yield of lint

being only about 8% less than X.1730A. The premium which would presumably be obtained for the superior lint quality of NT.2 might be expected to be more than sufficient to cover this difference in yield.

The comparative inspection plots' results support those from the larger tests.

(b) *American Varieties*.—A *Line Test* with 12 strains was done at Kadugli. 511D was considered worth testing on a larger scale next season.

Varietal Tests were grown in five localities under rainfall conditions, two in the Nuba Mountains (Kadugli and Talodi) and three in Equatorial Province (Opari, Kerripi and Maridi) and there was one at Kulud under irrigated conditions. Except at Opari, where soil irregularities favoured NT.14/35 and 513B, the growth, stand and reliability of the plots were sufficiently satisfactory for the direct comparison of varieties to be permissible.

The outstanding feature of the rain-grown tests was the success of 511C (a selection from Uganda S.G.85). The lint quality of this strain is also expected to show a marked improvement on Pump Scheme strain.

NT.15, (a "Harland's Hybrid" type) also did well and had a high ginning outturn.

At Kulud, blown sand caused poor and irregular growth. Nevertheless results were in accord with expectations based on previous trials and both 514D and XA1129 were superior in lint yield to Pump Scheme strain.

GRADING AND SPINNING TESTS.

Samples of lint from the more promising strains under trial were submitted for spinning and grading tests and acknowledgments are due to Messrs. Wolstenholme and Holland and to the British Cotton Industry Research Association for their courtesy in carrying out these tests.

The results show on the whole fair agreement with previous indications regarding the relative quality of the strains.

In the Egyptian series NT.2/34 from Barakat and NT.2/36 from Shambat spun and graded well, but in competition with Gash Sakel at Barakat NT.2/34 failed to show quite the superiority indicated last season; even so, however, it was priced a halfpenny a pound better than Gash Sakel.

Both grading and spinning showed X.1730A rather inferior to Gash Sakel. X.1730D and X.1730E proved no marked advance on X.1730A in quality, but certain later re-selections of this type showed promise.

Amongst the American Upland strains XA1129 and XA129 under irrigation at Kulud again showed marked superiority while strain 514D was also somewhat superior in spinning quality to Pump Scheme strain and graded extremely well.

511C under rainfall conditions was not very markedly superior to Pump Scheme strain this season, though again priced definitely higher by graders.

NT.15/35 gave weak yarn and was neppy and rough.

Durango was very immature, and though giving a strong yarn, was very neppy indeed and gave trouble in processing.

[Included by courtesy of the Uganda Government.]

UGANDA

COTTON EXPERIMENT STATIONS, BUKALASA AND SERERE. PROGRESS REPORTS FOR THE SEASON 1936-37

BUKALASA ZONE.

BY

G. W. NYE

GENERAL.

The yields in Buganda were good, but in general rather below those of the previous season owing to a dry period in July and August and to the complete absence of a second picking curve as a result of a dry period in November. The area under cotton in Buganda was greater than ever previously recorded ; this unfortunately means that much hill land is being opened up and exposed to severe erosion. It is, however, satisfactory to record a considerable improvement in spacing, and also in planting cotton across the slope. The native method of collecting weeds and rubbish in lines between the rows of cotton makes an effective check to erosion when the cotton is planted across the slope.

The average spacing in Buganda is $5' \times 3'$ giving approximately 3,000 plants per acre as compared with approximately 14,000 plants when the planting distance is $3' \times 1'$ the spacing recommended. There can be no doubt that the adoption of closer spacing would result in a considerable increase in yield.

Diseases and pests were not serious, wilt being much less in evidence than in the previous three seasons, and damage by Blackarm was negligible. Severe damage by *Lygus* and *Helopeltis* occurred in isolated instances, but damage by these pests was never widespread. Aphides were very numerous in the dry periods and undoubtedly checked growth. The grade of the crop was good, the percentage of stained cotton being less than usual. On the other hand the staple was short, even for Buganda, and averaged under 27 mm., while much of the lint was weak.

EXPERIMENTS.

Breeding.—The new selections were remarkable for high wilt infection, giving further evidence of the high susceptibility of B.P.50 and its derivatives. One re-selection from B.P.50 showed considerable power of recovery from wilt attack. B.181 was promising on account of habit and resistance to Blackarm. In the Pedigree Lines there was little of a spectacular nature, but B.P.141 and 142, derivatives of U.4/130 from Southern Rhodesia, promised well except for their susceptibility to Blackarm; their lint length was longer than any previous selections from U.4 made in Uganda and in addition much of that roughness, so typical of U.4, was absent from the lint.

Increase.—An increase plot of B.P.52 yielded over 1,000 lbs. seed cotton per acre. This strain shows a big advance in quality compared with Local and as its yield is equal to and often better than Local, it is being increased further in order to obtain commercial spinning reports on the lint and to provide sufficient seed for further increase. This variety is the most promising for the Western Area at present in any stage of increase; its sole drawback is that it is more susceptible to Blackarm than Local, although this does not always show up in observations made in the variety trials. It is anticipated that this variety will reach the Kawanda Seed Farm stage in the 1938/39 season.

Variety Testing.—The main variety trial at Bukalasa included 8 varieties. Local actually gave the highest yield of seed cotton followed closely by B.P.104 (S.G.23/8 derivatives) and B.P.52. The only U.4 derivative, S.P.87, gave a low yield of seed cotton, but its high ginning outturn gave it a much better position in the lint yields. The yield of Local was 1,371 lbs. seed cotton per acre as against 1,327 lbs. for B.P.104 and 1,268 lbs. for B.P.52. (These differences were not significant). In percentage of low grade cotton S.P.87 gave significantly more than any of the other seven varieties, a fact which reduces considerably its efficiency. An analysis for lint length showed significance, Local being shorter than all others, with a length of 26.8 mm., and S.P.87 next with a length of 28.7 mm.; B.P.52 gave 30.2 mm. The earliness of B.P.52 was again pronounced.

District Variety Trials were conducted at eight centres throughout Buganda, the four varieties being Local (control), B.P.52, B.P.79 and X (a mixture of S.G.23/8, B.P.52 and B.P.79).

In the aggregate B.P.52 yielded at an average of 979 lbs. seed cotton per acre as compared with 921 lbs. for X, 901 lbs for Local and 853 lbs. for B.P.79. The most spectacular result was at Kalagala where in October the plants were left as bare sticks after a severe

hailstorm. Despite this and the severe attack of Blackarm which followed, B.P.52 gave over 1,000 lbs. per acre.

Seed Distribution Scheme.—The purchase by Government of 750 acres of land adjoining the new Kawanda Agricultural Station is for the purpose of providing a minimum of 200 acres of cotton for increase. Under present arrangements the tenants will remain and grow cotton of the new strain. The stage after Kawanda will be a segregated area in Bugerere county ; this area is naturally segregated and is expected to produce up to a maximum of 2,000 acres of cotton a year.

Spinning Tests.—As usual spinning tests were carried out on samples from Uganda at the Shirley Institute, through the kindness of the British Cotton Industry Research Association, and at the Technological Laboratory, Bombay through the kindness of the Indian Central Cotton Committee.

The most important result of both series of tests was the superiority of B.P.52 over all other varieties. In the Shirley tests at 50's counts, B.P.52 gave a "strength $\times$ count" product of 2,367 as against Local 1,911, the former being given a Highest Standard Count of 68-70 and the latter of only 43-45.

Wilt.—Special attention is being paid to this disease owing to the likelihood of its spreading steadily every year throughout Buganda, where in most parts conditions are favourable to its attack. Specially infected wilt plots are being used at Bukalasa to test out all new varieties and strains for resistance. Seven American varieties, resistant to wilt in America, were obtained and tested ; complete resistance to wilt in Uganda was not shown by any of them and unfortunately the only one approaching the standard lint length of 30 mm. appeared to be more susceptible than the others.

Cultural Experiments.—The *Spacing trial* ($4' \times 1\frac{1}{2}'$ and $3' \times 1'$) again showed the superiority of the closer spacing under Bukalasa conditions this year for early (May) sown cotton. Two varieties were under test at both spacings—Local and B.P.52—but no differences in yield between the varieties were shown at either spacing.

Two per hole against One.—As usual 2 plants per hole gave a slightly higher yield than one plant. At $4' \times 1\frac{1}{2}'$ and wider spacings the policy is now to encourage two plants per hole. The effect at the closer spacing of $3' \times 1'$ has yet to be determined.

Inter-planting Cotton.—One row of beans or groundnuts had no effect on the cotton crop (at $4' \times 1\frac{1}{2}'$ spacing), but two rows of either depressed the cotton yields. Beans had a more depressing effect than groundnuts.

Green manuring for Cotton.—Green manure (*Crotalaria Juncea*)

increased the yield of the following cotton crop. When dug in 4, 6 and 8 weeks before the cotton was planted, the effect of the green manure was to give a significant increase in yield over control. The results from this experiment are so inconsistent that green manuring as at present practised cannot be recommended for natives.

Cotton Manurial Experiments.—In the experiment in which cotton follows tobacco to which manures are applied, cotton seed ash appeared to have a residual value as far as cotton was concerned. In the other experiment where cotton seed and green manure are under trial as fertilisers the residual effect of cotton seed was again evident.

Rotations.—The value of Elephant grass as a fallow crop in Buganda is under trial at Bukalasa. After three years of such a fallow the soil was in beautiful condition and high yields were obtained from all crops including cotton, groundnuts, sim-sim and tobacco.

SERERE ZONE.

BY

H. R. HOSKING and J. D. JAMESON.

METEOROLOGY.

The weather cycle of the previous season was repeated with the difference that the season began after the abnormally wet "dry season" experienced in January and February, 1936. As in the previous season, May and June were good planting months; the ensuing months were too dry for successful planting and the second rains were short and irregular. October and November were again abnormally hot and dry, inducing cotton to mature rapidly. Except for one heavy rain in December conditions for picking were good right on into January, and by the end of January the crop was virtually finished.

The rainfall for the year 1936 was 58.80 inches, 5.23 inches in excess of the mean for fourteen years, and largely due to the abnormal rains at the beginning of the year. Cotton yields were well above average, so once more there is evidence that a crop planted after a wet "dry season" does well. Yields in Teso District as a whole were even higher than in the previous season, but in the immediate vicinity of Serere the 1935-36 yield level was not quite realised, due no doubt to the partial failure of the second rains.

DISEASE AND PESTS.

Blackarm disease was not much in evidence, the reason again being the hot dry weather in the two critical months of July and November.

Considering the season, the proportion of stained cotton was high. Stained and rotted cotton was noticeable in the more Blackarm-susceptible strains. The local crop had a strong tendency to yellow in storage.

BREEDING WORK.

The Pedigree Line Series were divided into three groups. The first consisted of U.4/4/2 derivatives, the second contained re-selections of the S.G.29 hybrid group (S.P.102 in last year's report) and the third group were Serere re-selections from B.P.50. In the U.4/4/2 group the most successful strains were derived from S.P.92 of the previous season. They showed high resistance to Blackarm, fair resistance to jassid, gave very high ginning percentages and quite good lint. Their yields were good.

The S.P.102 derivatives were very resistant to Blackarm, resistant to jassid, gave good lint and fair yield, but their ginning percentages were lower than the U.4/4/2 derivatives. The B.P.50 derivatives

showed marked improvement over their parents in respect to Blackarm resistance and yield. They are resistant to jassid and give good lint ; but their ginning percentages are still very low although an improvement in this character is taking place slowly with re-selection.

Work was continued on the hybridisation programme. The crosses made in 1934/35 reached the F_2 generation and gave some interesting results. The back-crosses made last season were grown and although poor stands resulted, some good material was obtained. Judging from the Blackarm counts made on the F_2 generation of simple crosses, it seems reasonably certain that susceptibility to this disease is transmitted by the male parent in many cases. This reverses the opinion expressed in last season's report as it has now been found that the susceptible female parents in the F_1 generation carried the infection on the seed, thus masking the true effect of the male parent.

Six rows of Trinidad hybrids were grown. None of these gave good results ; no more work will be done on this group of hybrids as the crosses made at Serere between acclimatized cottons have proved far superior.

The New Selection Series consisted of thirty-one U.4/4/2 derivatives and twenty-nine re-selections from Nyasaland Upland. As in previous seasons all plants showing Blackarm disease were rigidly discarded. Eight selections made from N.17 growing in the districts gave some interesting results.

It is felt that straightforward selection has reached its limit on the material available at Serere, and the only hope of making further progress towards the production of high yielding disease-resistant strains with good lint suitable for the light soil areas is the crossing programme, or alternatively the introduction of a large number of diverse types from other countries.

FIELD EXPERIMENTS.

1. *Comprehensive Variety, Spacing and Sowing Date Trial—Serere.*—

This experiment was similar in design to that of last season.

Treatments :—

Sowing Dates :	May 16th, 1936	Varieties :	S.G.29 (control).
	June 15th, 1936.		S.P.88 (Nariama).
	July 15th, 1936.		S.P.89 (ex S.G.29 hybrid).
	August 15th, 1936		S.P.20 (U.4/4/2).
Spacings :	3' $\times$ $\frac{1}{2}$ '		S.P.84 (U.4/4/2).
	3' $\times$ 1'		S.P.87 (U.4/4/2).
	3' $\times$ 1 $\frac{1}{2}$ '		

(i) *Yield Results.*—The whole trial (consisting of 288 plots) gave an average yield of 717 lbs. per acre of seed cotton. In the previous season a similar trial averaged 967 lbs. per acre.

(a) *Varities.*

S.P.20 gave the highest yield.

S.P.84 and S.P.87 followed in a second group.

S.P.88 and S.P.89 made a third group.

S.G.29 was the lowest yielder.

(b) *Sowing Dates.*

The yields were in descending order by sowing dates, the August planting giving only 32% of the May planting.

(c) *Spacings.*

No difference.

(d) *Interaction of Variety and Sowing Date.*

The yields of S.G.29 relative to the other varieties were in descending order by sowing dates.

(ii) *Blackarm disease.*—Total lesions per plant and Blackarm intensity figures were obtained as in previous seasons. (Blackarm intensity = the number of lesions per pound of plant material; the plants being weighed at the end of the season. This expression gives a good index of intensity as due allowance is made for size of plant.)

<i>Varities.</i>	<i>Mean lesions per plant.</i>	<i>Mean Blackarm intensity.</i>
S.G.29	1.922	4.88
S.P.88	0.385	0.80
S.P.89	0.381	0.87
S.P.20	0.285	0.69
S.P.84	0.421	0.89
S.P.87	0.570	1.30
Least significant difference ...	0.099	0.32

It will be seen that S.G.29 is much the most susceptible of the varieties included in this experiment.

2. *District Variety Trials.*—Sixteen 4×4 Latin Squares were scattered over the area east of the Nile. The varieties S.P.20, S.P.87 and S.P.88 were included in all these trials, but for the first time the trials were divided into two series of eight each, using N.17 as control in Busoga and the Northern Province and S.G.29 as control in Teso, Bugwere and Budama. The sixteen trials averaged 734 lbs. of seed cotton per acre. Twelve similar trials averaged 911 lbs. per acre in the previous season.

(i) *Yield Results.*—In the N.17 area no significant difference could be demonstrated between control and the three S.P. varieties. These eight trials averaged 826 lbs. per acre of seed cotton.

In the S.G.29 area the three S.P. varieties gave yields very significantly better than control. This group of trials averaged only 649 lbs. per acre.

The variety S.P.88 was seriously attacked by *Helopeltis* in Bugwere and Budama Districts.

S.G.29 did extremely badly at all centres in areas where it is grown as the standard crop.

N.17 on the other hand did extremely well in parts of Busoga but relatively badly in Lango and Acholi. The latter result was most unexpected, although it is probable that had S.G.29 been grown in these two districts it would have done even worse than N.17.

(ii) *Blackarm disease*.—Mean lesions per plant :—

	Control.	S.P.20.	S.P.87.	S.P.88.	Least significant difference.
N.17 centres	0.834	0.173	0.429	0.243	0.072
S.G.29 centres	2.294	0.336	0.774	0.427	0.151

It will be seen that all the S.P. varieties showed greater resistance than either of the control varieties N.17 and S.G.29.

Also it is clear that taking a line through the S.P. varieties, N.17 is more resistant than S.G.29. (This result was corroborated by a miniature variety trial at Serere).

COTTON SEED MULTIPLICATION.

S.P.87 was grown as the main bulk increase in the 40-acre stage at Serere. Owing to a severe attack of *Lygus* the yield was disappointing being only 656 lbs. per acre of seed cotton. The plants were tall and spindly as a result of the suppression of the sympodia and the crop was mainly set high up on tall spindly plants. The main crop did not ripen until December. A slight top crop ripened in January, and by February the crop was virtually finished.

S.P.84 was planted up in all available isolated areas at Serere as a second string to S.P.87. This plan was very fortunate as it was shown during the season that S.P.84 is undoubtedly the better cotton of the two. In all 7,500 lbs. of seed cotton were obtained (the yield averaged 800 lbs. per acre) and this gave sufficient seed to plant Mulondo in the next season.

468 acres of S.P.20 were planted by natives in Mulondo. This averaged 491 lbs. per acre of seed cotton. It should be mentioned that 82 acres planted in August and September failed almost completely owing to lack of rain late in the season.

The 4,000 acre stage averaged 193 lbs. per acre of seed cotton with the variety S.G.29.

The 30,000 acre stage average 251 lbs. per acre also with S.G.29.

SPINNING TEST RESULTS.

Reports on the spinning behaviour of S.P.84 compared to S.G.29 have been received from the Shirley Institute and the Indian Central Cotton Committee.

The results are summarised below.

INDIAN CENTRAL COTTON COMMITTEE.

Crop.	Variety.	Count $\times$ Strength.			Waste %.		Total loss %.	Neps per yard.
		30's.	40's.	50's.	Blow Room.	Card Room.		
1935/36 ...	S.P.84	2,193	2,064	1,800	2.9	8.4	11.3	1.4
1935/36 ...	S.G.29	2,127	1,912	1,790	6.6	9.2	15.8	4.2
1936/37 ...	S.P.84	2,214	2,080	1,830	3.6	8.8	12.4	3.8
1936/37 ...	S.G.29	2,163	1,944	1,755	5.4	9.1	14.5	2.1

SHIRLEY INSTITUTE.

Crop.	Variety.	Count $\times$ Strength.		Waste %.		Total loss %.	Spinning Breaks per 100 Spindles per hour.	
		50's.	64's.	Blow Room.	Card Room.		50's.	64's.
1935/36 ...	S.P.84	2,343	2,074	0.9	8.7	9.6	0	10
1935/36 ...	S.G.29	2,318	1,993	2.2	12.0	14.2	5	19

Shirley Institute's Summary :—

"S.P.84 is one of the best in appearance as well as being the strongest, so that this can be considered the best spinning cotton of the Eastern Province group. S.G.29 though very little weaker than S.P.84 is not so good in yarn appearance."

The 1936/37 Shirley Institute's reports are not yet to hand.

To summarise the characteristics of S.P.84 and S.G.29 :—

Yield performance.	At Serere, 1936/37, over four sowing dates S.P.84 yielded 28% more seed cotton per acre than S.G.29.
Blackarm resistance.	In the same trial S.P.84 gave only 0.42 lesions per plant as compared with S.G.29's 1.92 lesions per plant.
Ginning percentage.	S.G.29 gins commercially at about 30.5%. S.P.84 ginned out at 34.9% in 1937. This means that S.P.84 gave over 46% higher yield of lint per acre than S.G.29.
Spinning performance.	S.P.84 has stronger yarn, less waste and fewer breaks and neps than S.G.29.

[Included by courtesy of the Tanganyika Government.]

TANGANYIKA TERRITORY.

UKIRIGURU EXPERIMENTAL STATION, AND NYAMAHONA EXTENSION, UZINZA, PROGRESS REPORT FOR THE SEASON 1936-37.

BY

D. THORNTON.

GENERAL.

At Ukiriguru and at Mwabagole rice sub-station experiments dealing with both native food and cash crops were laid down; in addition, other activities such as demonstration work, seed multiplication, training of staff, etc., were carried out. The Nyamahona station, which is still in the development stage, is becoming an agricultural centre serving both the controlled peasant-holding settlement and a rapidly developing area of newly opened-up country.

METEOROLOGY.

An abnormal season was experienced; the early rains were satisfactory and growing conditions were good, but towards the finish very heavy rains coupled with dull cold weather caused considerable damage to all plant growth; instead of a gradual onset of the dry season there was a sudden change to a bright hot period accompanied by strong drying winds causing further damage, especially to cotton.

EXPERIMENTAL WORK.

Cotton.—In all experiments yields were much below normal mainly owing to very heavy boll-shedding which took place during the wet weather, but with a few exceptions significant differences between treatments were obtained.

The main work on cotton was the continuation of strain trials as in previous seasons. Five trials containing twenty-two selections made from the local cotton in previous years were laid down and a number of these have again proved much superior yielders to the local cotton.

The following selections were outstanding :—

				Per cent. increase in yield over local cotton.
Selection No. 613	...	...	19	
„ „ 457	...	...	31	Trial I A.
„ „ 561	...	...	67	
„ „ 378	...	...	35	Trial I B.
„ „ 570	...	...	33	
„ „ 527	...	...	62	Trial I C.
„ „ 601	...	...	25	

Strain No. 561 was the best in its trial last season and continues to fulfil its early promise.

As far as tests have shown, with the exception of No. 613, all selections are at least equal in quality of lint to the control, and some show an improved ginning percentage.

Strain 613, despite having the lowest percentage increase in yield, shows value, as reports on its spinning tests were very satisfactory.

In a variety trial the local cotton was compared with (1) a mass selection from local cotton; (2) a mixture of the best selections from Ukiriguru; and (3) No. 998, a U.4 derivative supplied from Shinyanga.

The mixture of selections gave a significantly higher yield than all the others. 998 was a higher yielder than local.

In the cotton plant stand trial, which compared the effects of leaving 2, 3, 4 and 5 plants per hole, no significant differences in yield were obtained.

No significant differences in yield were obtained in a trial of four treatments of cotton grown on the heavy black soil; the four treatments were (1) planted on ridges; (2) planted on the flat; (3) a dressing of 3 tons per acre of farmyard manure and planted on the flat; (4) sunnhemp dug in, cotton planted on the flat. Treatments (3) and (4) gave the highest yields and indicate a possibility of developing the extensive areas of these soils.

The time-of-planting experiment has again shown the value of early planting, fortnightly plantings were carried out from the 31st October until the 15th March, the first sowing gave the highest yield of cotton and yields declined progressively the later the time-of-planting; as in last year's trial, a sudden large drop in yields took place for plantings after December 30th. Only a few years ago most of the district cotton was not planted until January and February, but a great improvement is now shown in this respect.

Other Crops.—The sorghum crop is one of the most important food supplies of the local natives and variety trials of the different classes of sorghums were repeated again this season.

Yields obtained confirm the results of previous trials ; out of the twenty-four varieties tested seven are definitely superior yielders and selection work within these varieties has been started.

In the open pannicked Wiru sorghums trial, native bulrush millet and an introduced awned millet were included and proved equal yielders to these light soil sorghums ; there was no difference in yield between the local and introduced millets.

The resistance of the three main grain crops—maize, sorghums and bulrush millet—to damage by *striga* gave no significant results in the degree of the incidence of *striga*. But Kenya hybrid maize, an introduced variety, proved a significantly higher yielder than both the sorghums and bulrush millet.

Muratha maize, a new introduction from Kenya, gave the highest yield in a trial with Kenya hybrid maize, Johnson County and Katumbili ; the last variety is a selected strain of a native maize and is proving a valuable selection, as not only is it a fair yielder but is very quick maturing.

The groundnut work has been transferred to Lubaga Experiment Station, Shinyanga, and all selections made at Ukiriguru have accordingly been sent to that station. One variety trial was carried out ; in this a mass selection from the native groundnuts proved a significantly higher yielder than the ordinary native mixture, but the difference in yield between it and Barberton and Virginia Bunch groundnuts was not significant.

A number of plant introductions and selections were made during the year. Of the sorghums an introduction from Kenya, Dobbs, proved good and with two new local selections, Kandi and Mbala, is being put in next year's trial.

Other crops under observation included selections of cowpea, sweet potato, and soya bean.

CULTURAL EXPERIMENTS.

The adoption of improved agricultural practices by the native cultivators to maintain fertility is becoming more imperative and manurial trials over a series of years have been carried out and are being continued. Few of this year's trials gave significant results owing to the uneven growth due to water-logging, but in all trials of the different rates of applying farmyard manure treatments gave greater yields than the unmanured controls.

In addition to the fact that small dressings of farmyard manure have given considerable increases, the results of three seasons' trials to test the use of one, three and five tons per acre of farmyard manure have shown that dressing at the rate of three tons per acre gave greater returns than both the one and the five-ton application; the use of manure at such a rate is well within the reach of the native cultivator and a number of demonstrations in the district have been laid down in order to bring these facts under his notice.

Where fly or other reasons preclude the keeping of cattle and the use of manure, resting the land or growing green manures are the alternatives, and an experiment testing sunflower, bulrush millet and sunnhemp as green manures was laid down in 1935, cropped with bulrush millet that year and cotton in 1936. Significant increases in yield were then obtained by the use of sunnhemp. This season a 28% increase of sorghum over no treatment was obtained, but this is insufficient for significance.

Two new trials of manuring with sunnhemp were laid down. One was cropped with maize, the other with bulrush millet. Increases in yield were obtained from the treatments, but insufficient for significance. The sunnhemp was slow in breaking down and the residual value is to be tested with cotton next year.

In the spacing of sorghum trial, line planting at spacings of one, two, three, four and five feet apart were compared with the native method of broadcasting. The spacings at one, two and three feet gave significantly higher yields than the broadcast and planting at four and five feet.

OBSERVATION WORK.

In the crop exhaustion plots each area is planted with the same crop every year and receives no manurial treatment of any sort. Yields from them show great seasonal variation and are much lower than the average farm crop. Nevertheless when compared with measured yields from native farms, they show a better return despite the low state of fertility of the plots; this is probably due to the greater attention paid to the plant stands and to cleaner cultivation.

The interplanting of cotton with other crops shows a tendency to spread and observation plots were laid down; cotton interplanted with wide-spaced, tall sorghum was a complete failure and shows that cotton under our conditions to be intolerant of any shade.

Unless the cotton were widely spaced, the interplanting of cotton with groundnuts made cultivation and harvesting extremely difficult and on the Lake Province ridge system of cultivation it will be necessary to plant cotton and groundnuts on alternate ridges.

NYAMAHONA EXTENSION, UZINZA.

Although considerable development work has been carried out since the last report was written, more is required before the station takes its place in the scheme for cotton seed multiplication.

Cotton on the "Miombo" soils on the Northern section of the farm was poor, but was much better on the heavier soils in the new area. The "Miombo" soils appear to be excellent for root and bean crops.

No new lands were developed in the northern area, but forty acres of land more suited to cotton were broken in ready for next season's cropping.

The area is now comparatively free from fly and, with the exception of injuries, the cattle have kept well and have been worked steadily.

SEED FARM.

In addition to ordinary seed some seventy-five tons of introduced or selected varieties were produced on the three stations; over thirty tons have already been issued. The main crops multiplied were maize, sorghum, millet, rice and groundnuts, and smaller quantities of beans and sunnhemp.

The work oxen on the farm were used continuously throughout the year, the only supplementary rations to grazing being crop refuse and silage. Experience has shown that provided there is ample good grazing available there is no need for much supplementary feeding, and that only towards the end of the dry season.

PEASANT HOLDINGS.

At both Ukiriguru and Nyamahona the settlers experienced a difficult year and some failures have to be reported, but most of them are contented and are beginning to understand the advantages and principles of a system of planned agriculture. All settlers obtained ample food crops, most of them more than the ordinary cultivator, though their cash crops gave lower returns than in previous years. But a welcome sign showing that they are taking root on their holdings despite difficulties is the fact that a number are building improved houses.

At Ukiriguru all the settlers have cattle and are becoming quite skilled in using their work oxen and have bought the implements previously loaned to them. Cattle are being taken into the Nyamahona settlement holdings now that the risk of fly has been reduced, but as yet none have been used for work.

New settlers are taking up holdings at Nyamahona and it is expected that there will be two hundred before the next cropping season; at present there are one hundred and sixty-five.

As there is no land available at Ukiriguru no new holdings have been started, but in the chieftdom of Bukumbi a number of cultivators are using kraal manure for the first time and there is an increased demand for ploughs which led to forty-six work oxen being trained for native cultivators at Ukiriguru during the year.

In the densely settled areas the difficulties of getting cultivators to exchange plots so as to get a unit holding are too great to be overcome and extension work in these areas has been concentrated on getting them to farm, instead of merely cultivating their homestead plots, and as they find out the advantages, to induce them to apply the system of mixed farming to all their plots ; in Bukumbi there are signs that this is being attained.

EDUCATION.

Apart from the value of Ukiriguru as a demonstration, approximately two thousand natives from other areas were conducted over the farm in parties and keen interest was shown on all occasions.

As most of the labourers employed on the farm are local cultivators a class was held once a week at which agricultural and general subjects were discussed ; although most of them are uneducated they showed great interest and enjoyed the afternoon and evening classes.

All staff employed in the district have now had some training at Ukiriguru and as work permitted they were called in and received refresher courses ; new recruits now work for at least one year on the farm and a steady improvement in the district work has been brought about.

Provision has been made for the establishment of a permanent training centre for field staff at Ukiriguru which will fill a long-felt want.

LUBAGA EXPERIMENTAL STATION, PROGRESS REPORT, 1936-37

BY
H. GILLMAN.

WEATHER.

The rainfall for the 1936-37 growing season was the highest yet recorded in the Shinyanga District, totalling at Lubaga 41" (November-May) and as much as 47" at Ibadakuli five miles further East. As the distribution was good, without long dry spells or torrential storms, there was no serious damage to any of the crops.

COTTON EXPERIMENTS.

Variety Trial No. 1.

Variety.	Mean yield lbs. per acre.	Order of yield in 1936.	E.C.G.C. Report (1936 Crop).		
			Length of staple.	Strength of staple.	Value pence per lb.
Mz561	945	11	—	—	—
998	907	1	1"-1 $\frac{1}{16}$ "	Medium	8·40d.
9355R	886	7	—	—	—
955	850	4	$\frac{7}{8}$ "-1"	Weak	7·80d.
U.4 Bulk	844	3	1"	Medium	8·10
921	840	2	—	—	—
920	829	8	—	—	—
U.4/4	826	5	1"	Strong	8·55d.
9264R	809	10	—	—	—
Mz572	784	12	—	—	—
U.4/4/2	739	6	$\frac{7}{8}$ "-1"	Weak	7·80
Mz Bulk	665	13	—	—	—
Mz570	441	9	—	—	—

Difference required for significance ($P = .05$) = 133 lbs.

For the third year 998 (a Barberton selection from U.4) has given a significantly higher yield (22·7%) than the local native grown U.4/4/2 cotton. Also this year a Mwanza selection (Mz561) has yielded significantly more than the control, although in previous years all the Mwanza cottons (Uganda Upland derivatives) have given poorer yields. This is presumably a response to the heavy rainfall experienced, which produced conditions more comparable to the Mwanza lake shore area.

The report from the Shirley Institute received through the Empire Cotton Growing Corporation on the main characters of five of the selections (1936 crop) is included above and shews 998 to be superior to U.4/4/2 in lint qualities.

Variety Trial No. 2.—This trial, comparing six varieties and strains with U.4/4/2 gave no significant differences, owing to the large variation in plot yields within treatments. 998 however again gave higher yields than the control.

Selections.—201 selections including 998 and U.4/4/2 strains, other selections from South Africa, and various U.4 crosses, were planted

out in small plots, and 37 of the more promising are being kept for further observation and trial next year. Most of the above selections made good growth ; but the seven U.4 crosses received from Barberton, were late in maturing, and gave extremely low yields.

Further single plant selections have been made from district and farm 998 and U.4/4/2 cotton.

Time-of-Planting Trial.

Planting Date.										Yield (lbs per acre).	
15th December	...	...	...	...	...	...	...	...	...	952	
1st January	...	...	...	...	...	...	...	...	...	876	
15th January	...	...	...	...	...	...	...	...	...	628	
1st February	...	...	...	...	...	...	...	...	...	464	
15th February	...	...	...	...	...	...	...	...	...	228	
1st March	...	...	...	...	...	...	...	...	...	60	

Difference required for significance ($P = .05$) = 74 lbs.

Rains were late starting this year, and the 15th December was the first date on which planting could be done. Again the value of planting early has been amply demonstrated.

Number of Plants per Hole.—In this experiment, the differences in yield were low on account of soil heterogeneity and white-ant damage, but the results indicate that thinning down to two plants per hole gives significantly higher yields than either one or three plants per hole.

Cultivation Trial.—A complex experiment including comparisons between flat and ridge cultivation ; one, two, three and four plants per hole ; and shallow as against deep hoeing, gave no significant difference on account of the waterlogged condition of half of the experiment throughout the month of April.

Residual Manurial Trial.—The residual effect of 2, 4 and 6 tons per acre of farmyard manure applied in 1935–36 to bulrush millet gave heavier yields of cotton for each treatment, although only the yield from the 6-tons application was significant over control.

Cotton Demonstrations.—Half-acre plots demonstrating various practices in use or which the native wishes to adopt, gave the following yields in lbs. per acre.

Demonstrations (all planted on the flat).						lbs. per acre.	Value in shillings.
A.	Cotton	planted	in	lines	...	302	24/-
B.	Cotton	broadcast	...	...	...	341	27/-
C.	Cotton	interplanted	with	groundnuts	...	242 cotton	18/50
					...	278 groundnuts	11/-
D.	Cotton	interplanted	with	bulrush millet	...	2 cotton	Nil.
					...	296 millet	9/-

Cotton Seed Multiplication.—Six fields (29 acres) of 998 were planted up for seed multiplication purposes and as a field scale trial. The average yield was 330 lbs. per acre, the individual fields ranging from 190 lbs. to 517 lbs. an acre.

GROUNDNUTS.

Variety Trial.

Variety.							Yield, lbs. per acre.
Barberton	...	...	...	...	...	...	1,044
Migongo	...	...	...	...	...	...	1,044
Karandi	...	...	...	...	...	...	1,040
Kwitunda	...	...	...	...	...	...	972
Virginia Bunch	...	...	...	...	...	...	972
Lumbalala	...	...	...	...	...	...	660

Difference required for significance ($P = .05$) = 164 lbs.

Lumbalala, a large shelled local variety was significantly poorer than all the other five. Higher yields would probably have been obtained from the Virginia Bunch and Barberton varieties had a closer spacing been used.

Selections.—Selections of various local and imported varieties gave a number of promising results, the best, a native variety, yielding at the rate of 1,450 lbs. per acre.

MAIZE.

Variety Trial.

Variety.							Yield lbs. per acre.	No. of days to maturity.
Kenya Hybrid	...	...	...	...	...	...	3592	137
Potchefstroom Pearl	...	...	...	...	...	...	3436	137
Marathi	...	...	...	...	...	...	2936	130
Katumbili	...	...	...	...	...	...	2852	110
Zurunge	...	...	...	...	...	...	2616	113
White Congo	...	...	...	...	...	...	2532	119
Gembe	...	...	...	...	...	...	2432	113

Difference required for significance ($P = .05$) = 492.

In spite of damage from white ants and storms, significant differences were obtained, and for a second season Kenya hybrid and Potchefstroom Pearl gave higher yields than any other variety. The differences between the three native varieties were not significant, although Katumbili again showed strong indications of being a high yielding and early maturing variety.

Manurial Trial.—The object of this experiment was to determine the optimum application of farmyard manure on bulrush millet. Treatments of 2, 4 and 6 tons per acre gave significantly higher yields than control, but the experiment also showed that in this first season there was no significant difference between the yields from the various treatments.

DEMONSTRATIONS.

Exhaustion Plots.—The three exhaustion plots laid down last season were again planted to the same crops and gave the following yields :—

	Yield lbs. per acre, 1937.	Yield lbs. per acre, 1936.	Man-hours required to cultivate and plant one acre.
Cotton	226	521	56½
Virginia Bunch Groundnuts	1,212	1,083	166
	(unshelled)	(unshelled)	
Sorghum	1,017	784	113

Comparison Between Flat and Ridge Cultivation of Maize.

<i>Treatment.</i>	<i>Yield, lbs. per acre.</i>	<i>Man-hours required to cultivate and plant one acre.</i>
Flat cultivation	2188	110
Ridge cultivation	2788	118
Tie-ridge cultivation	2698	154

The demonstration was laid down to show the advantage of ridge over flat cultivation, and a tie-ridge plot was included to measure the amount of increased labour that would be required for this method of cultivation. The ridge cultivation plot, requiring only 7% increase in labour, gave a 21% increase in shelled maize per acre.

EDUCATION.

Several families have been in residence throughout the year under the new adult school project. They acquire practical experience by working as labourers on the experimental area and on the seed farm, and also by assisting the blacksmith, carpenters and mason. Twice a week they attend evening classes in reading and writing, and periodical classes in elementary agriculture. Two of these families have now been selected for settlement on peasant holdings.

Beside the adult school, special short courses have been held covering the following subjects:—General agriculture for the native agricultural field staff; anti-erosion measures (including laying out contours), for selected members of the above staff, and a number of instructors from other districts as well as a course in market supervision for the market clerks.

During the main growing season one day a week was set aside for conducting parties of natives round the farm and explaining to them the various objects and activities of the Experimental Station. Over 300 sub-chiefs, village headman, and interested peasants made use of these facilities.

As in previous years the ploughing school was available for the training of oxen, and although rinderpest quarantines had seriously hindered the movement of stock, 24 oxen have been sent in to Lubaga.

As well as the above facilities available at the Experimental Station, arrangements have been made with various firms to have on permanent display a number of the more useful agricultural implements. The prices are clearly marked and the native now has an opportunity to inspect the implements he requires. The orders are then placed through the agricultural officers.

PEASANT HOLDINGS.

The three peasant holders have had a very good year for their food crops and groundnuts, but on the other hand have received poor

yields from their cotton, with the result that the cash returns this season are considerably lower than those obtained in 1936. A fourth holding is being established at Ibadakuli.

DEVELOPMENT OF STATION.

The policy of protecting the farm against soil erosion by a series of Havilland contour banks was completed at the beginning of the season, and the system has stood up extremely well to the record rains experienced. Also the *Cassia siamea* windbreaks, all of which had to be re-planted, have this year made excellent growth, and already stand 3-4 feet high.

The dam on which work was commenced last year has now been enlarged, and a second deep tank excavated in the middle.

Other capital improvement work included the erection of an engine house, another model native house, a poultry house, the rebuilding of the kitchen and food store, and also of the dairy and cow byre which were unfortunately both burnt down during the earlier part of the year.

MOROGORO EXPERIMENTAL STATION AND KINGOLWIRA EXTENSION FARM: PROGRESS REPORT FOR THE SEASON 1936-37

BY

N. R. FUGGLES-COUCHMAN.

SEASONAL.

Rainfall.—The season has been one of low rainfall. The short rains (November to December, 1936) were average near the mountains, but failed at Kingolwira. The long rains (March to May, 1937) were late in commencing and of short duration and intensity. As a result yields of grain and legume and root crops are rather below average while cotton has been well suited by the dry and sunny months of June to August, and has yielded very well.

MOROGORO EXPERIMENTAL STATION.

Experimental work.—All cotton experiments were transferred to Kingolwira this season as climatic conditions at the foot of the mountain have proved unsuited to the optimum growth of the crop. Fifteen

experiments dealing with cultural methods, manuring and variety trials were planted while field work on cassava mosaic was continued. A collection of cassava and sweet potato varieties from all over the Territory has been made, planted under irrigation, from which it is hoped to find high yielding varieties, and a strain of cassava resistant to mosaic.

Trials relating to local problems.—(i) *Cultivation methods.*—This season the value of planting maize on ridges, as opposed to the normal native method of planting in undug ground, was again proved, although hoeing of the soil to a depth of 3" did not prove better than the native method this year. The plant stand under ridging and digging was definitely better than in the native method.

It is doubtful whether natives could ever be persuaded to make ridges in their maize fields, but peasant holders with a ridging attachment to their ploughs would be able to follow this apparently better practice.

(ii) *Variety trials.*—The local variety of sorghum has for the third year given the highest yield and heaviest panicle weight. This variety is apparently unpalatable to birds.

The sweet potato variety trial gave somewhat similar results to last year, except that Calabash Leaf, a variety from Rhodesia, proved the best yielder of both roots and vines, enhancing the general good all-round character apparent last season.

(iii) *Green Manuring.*—The value to maize of turning in a 6 weeks' old crop of sunn hemp was again well proved this year, the yield of maize being increased by 64%. There appeared to be no residual value from the green manuring of the previous season, replanted this year with *Pennisetum typhoideum*.

(iv) *Manuring with Compost and Farmyard Manure.*—Results have been disappointing so far. During 1936 the only applications which gave significant results with maize were 2 tons of cotton seed compost and 4 tons farmyard manure. Dressings of 6 tons of farmyard manure failed to show any response. This season no significant response has been recorded from any dressings, and no significant increase has been obtained from the residual manurial value in last year's plots. There may be several factors which are inhibiting or reducing the potential value of the manure, and it is hoped to gain some information on this matter next year.

(v) *Cassava Investigations.*—The technique of exposing seedlings of cassava to infection of mosaic disease, by planting between rows of diseased material, described in last year's Report, has not eliminated as many plants as had been expected. The establishment of the

diseased rows has been a matter of some difficulty so that seedlings are probably not in close enough proximity to diseased plants. It is hoped to overcome this by much earlier planting of the diseased setts to form a regular trial ground with well-established hedges of diseased material, where cuttings from seedlings which have remained free from infection are further tried out. It appears that in this area there is a low resistance to the disease and a search for tolerant, rather than resistant or immune strains, will have to be made. Two imported varieties, one from the Gold Coast and one from Trinidad, so far show promise of being resistant types.

The Dairy Herd.—Milk yields have remained satisfactory and native cows have maintained their improvement under the system of stall-feeding followed. Small increases in daily milk yields over previous lactations have been recorded in most cases. Edible canna and *Dolichos Lablab* vines, remain the chief components of the ration, together with supplements of *Pennisetum purpureum*, sweet potato tops and roots and edible canna roots, and roughage from the farm. The condition of the young stock shows the value of a small ration of steamed bone flour fed until 18 months old.

The herd has been infected with trypanosomiasis to a greater extent this year. The tsetse position here is very obscure. No flies have ever been caught or seen on the farm; fly rounds through possible fly-infested bush and old rubber plantations within two miles of the farm have failed to show the presence of fly. Lorries coming into the town, about $\frac{1}{2}$ mile from the farm, probably do occasionally carry *G. morsitans* which may find their way to the farm, but there is no proof. A disappointing feature is the apparently greater proportion of relapses some four weeks after the completion of a course of treatment.

A derelict piece of land has recently been contour ridged and planted with *Cyanodon plectostachyon* to give extra grazing, and a quarantine area for cattle coming from the Central Province, prior to their introduction into Kingolwira, which is free from East Coast fever.

The composting of all farm residues is a routine on the farm and experiments in composting coconut husk have been commenced. This type of compost should be of value to the Dar es Salaam dairy owners who frequently have coconut plantations. Lime obtained from a deposit on the Kingolwira farm, is being used in conjunction with wood-ash in some compost heaps, with a view to assisting the breaking down of the more woody plant residues frequently composted.

KINGOLWIRA EXTENSION FARM AND PEASANT SETTLEMENT CENTRE.

The past year has been one of satisfactory development and consolidation. While the tsetse fly position continues to give cause for some anxiety, however, as will become apparent below, it has not checked the progress of the scheme. Conditions have been favourable to crop production, which has given confidence to the native peasant holders and has given rise to a measure of favourable advertisement amongst natives living in areas some distance from Kingolwira.

Cotton Selection and Experiments.—(a) Some 400 single plant selections from local seed, 998, and U.4 derivatives were made in 1936, and have been under observation in progeny plots, some of the best of which have yielded over 3 ozs. per plant under somewhat adverse soil conditions. Some selections from the A.F.C. strains from Barberton show promise, but their lint is not up to that of the best local strains, rarely exceeding $1\frac{1}{8}$ " compared with a full $1\frac{3}{16}$ "— $1\frac{1}{4}$ " for the latter.

The 119 selections from local cotton carried forward from 1936, were planted with controls in a variety trial laid out on the pseudo-factorial system designed by F. Yates. Some of the outstanding selections have established their superiority in this trial. The yields of the best were at the rate of over 500 kilograms of seed cotton per acre compared with 420 kilograms from 998, a proved heavy yielder under local conditions, and 380 kilograms from local seed. Further, the lint of the best strain is of excellent length and silkiness. But the ginning outturn from the strains remains low compared with 998—between 30% and 32% compared with 34–36% for 998.

Further single plant selections have been made from local cottons, and from observation plots of various imported strains including hybrids from Trinidad, received from Nyasaland. The most promising of the latter in appearance, yield and lint appear to be (U.4 × Over the Top) × U.4 and (Over the Top × SG.27) × U.4

A variety trial of various imported strains of U.4 derivatives, local selections and seed from Mwanza failed to give significant results with regard to yields; 998 showed the best yield closely followed by a bulk seed of the best of several local strains. In ginning outturn 998, 995, 920, and U.4/4/2, amongst others, were significantly superior to local strains and S.P. strains. The former ranged between 37% and 35% compared with 33.5% to 31.5% for the latter.

(b) Five experiments with cotton were planted relating to the following problems:—(1) Interplanting and spacing; (2) Viability and vigour of seed from No. 1, 2 and 3 grade seed cotton; (3) Cultivation trial; (4) Plant stand trial and topping; (5) Cultivation trial: the period taken from the first clearing of bush to give average crops.

All the above experiments were planted on a deep red soil which is tardy in producing good crops. As a result yields in all experiments were very low.

Interplanting with groundnuts significantly depressed the yield of cotton planted $3' \times 3'$; cowpeas similarly depressed the yield, but not significantly. A spacing of $3' \times 1' 6''$ did not give a significant increase over the more widely-spaced cotton.

There appears to be no difference in viability or vigour of seed from 1st, 2nd or 3rd grade seed cotton. The crop from the 3rd grade seed was actually slightly greater than that from 1st grade seed.

In the cultivation trial, cotton planted on ridges gave a 100% increase over cotton planted by the usual native practice of planting in undug soil, but showed no significant superiority over cotton planted in soil dug to 3". Difference in yields between plant stand of 1, 2, 3, and 4 plants per hole showed no significant results, but the indications were that the normal practice of 2 plants per hole $3' \times 3'$ apart is sound.

(c) Two experiments were planted which deal with the problem of lack of fertility in the deep red soils on the ridges when freshly cleared from bush. One includes maize, groundnuts, cotton and bulrush millet. In both maize and bulrush millet the increases in yield in land in its second year is of the order of 150–200%. Deep digging in the first year, *i.e.*, the equivalent to ploughing, gave a 50–80% increase in yields over the usual native method. Cotton however, did not show such marked increases, there being no significant differences between yields from land in its second year of cultivation, and that newly opened this year; nor was there any difference between dug land and undug land.

Cotton Multiplication Plots.—Thirty acres were planted on the farm with local seed, and some 40 acres with 998. The local crop has been indifferent, and that from 998 average. All the peasant holders were supplied with 998 and reaped very big crops from it, which have yielded over 400 kilograms per acre in some cases, compared with last year's figure of 217 kilos per acre. Moreover the crop has been of good 1st grade quality and the lint appears to be rather better than in 1936. It has cropped so heavily on one or two holdings that a native with four acres has found it more than he could do to keep up with it in picking. There appears no doubt from the past two seasons' experience with 998 that it is admirably suited to local conditions, its only draw-back being the inferior quality of the lint compared with local 1st grade.

The Tsetse Position.—It can be safely said that our chief enemy and danger on the farm is *G. pallidipes* from the riverine forest, which

also infests the peasant holdings near the river. *G. morsitans* only occurs in the peasant holdings which are contiguous with uncleared bush, and on the outskirts of the barrier clearing of the farm; occasionally they are intercepted by the fly boys on vehicles and pedestrians. The measures taken against *G. morsitans* can be considered to be very satisfactory. The numbers caught on fly rounds never approached the numbers in 1936, although the dry season low figures this year are not obviously different from those of last year.

The position with regard to *G. pallidipes* is much less satisfactory. It has been established that during the wet season these flies tend to migrate from the heavy riverine forest to patches of drier thicket scattered about the farm, which has not been felled. In the ordinary way the flies do not appear in the cleared land along the river beyond a distance of 100 yards from the river. Presumably in their migration, and on unapprehended natives coming from near the river, these flies have continued to carry infection to the cattle. As a first step towards what is hoped will be a control of the next season's tsetse migration, the thickets have all been felled this year. If migration still continues, and even if it does not, it may be necessary to clear the riverine forest, and develop the other side of the river, to drive back *G. morsitans*, to which the riverine forest is an effective barrier at present. Such an expedient however will be very expensive.

The Peasant Settlement. — (a) *The Peasant Holders.* — There were thirty-five natives occupying holdings for this crop season; their crops have been generally above average. From 3 to 8 acres were put under cultivation by holders, depending on the time of their taking up the holdings. Groundnuts and cotton have been the chief cash crops. Up to Shs. 30/- was realised for groundnuts. Some men will draw over Shs. 300/- for their cotton crops, so that there will be plenty of surplus money in the holding. Attention is now being paid to encouraging the use of that money in the betterment of the holder and his family, the first object being to interest them in good houses of sun-dried bricks. It is too early for them to have cattle and implements, but future cash will be directed into such channels. Excellent sorghum crops were harvested, but little maize. The holders appear very contented with their lot, and seem to realise that there is something in the scheme. A sign of the native appreciation of the scheme is that applications are being received in increasing numbers from natives to take up holdings this year without any propaganda from the Department.

(b) *The Demonstration Holders.* — Very satisfactory progress can be recorded here. One holder put down nine acres under the hoe and used

a cultivator bought on an advance, with cattle loaned by the farm. He will receive over Shs. 300/- for his cotton crop alone, and he sold Shs. 25/- worth of groundnuts as well. Cattle sheds have been built and the first demonstrator has now been supplied with two work oxen and a cow in calf, which he will pay for when he shows he can look after them. This he is rapidly doing.

The Prison Farm.—This project, explained in the report for 1936 can be said to be progressing very satisfactorily. Two burnt brick houses for long term prisoners have been completed, a burnt brick kitchen erected, and a guard room. Some 75 short and long term prisoners have been in residence. Ten picked long-term men who will gradually be let out on licence, have worked together on a demonstration holding. Two have now taken up their own holdings. These men are being specially assisted in the building of their houses and the preparation of their land by other prisoners so that they may get a good start. Cattle will be introduced as soon as the fly position makes it safe to do so ; these and implements and any real costs in building houses, etc., will be given as an advance to be repaid from crop proceeds.

The short-term men have been employed on the cultivation of 40 acres of food crops, clearing thickets and bush, and in building in the camp. Good yields of groundnuts and cowpeas were obtained. A herd of ten oxen and five heifers have been purchased for this farm, and for peasant holders.

MPANGANYA EXPERIMENT STATION, RUFIJI, PROGRESS REPORT FOR THE SEASON 1936-1937

BY

H. MARSLAND.

INTRODUCTION.

The work of the year has consisted mainly of the regeneration of local strains of cotton and rice. In addition, trials with imported strains of both crops have been conducted.

Climatic conditions were little better than those reported for 1936. Acute drought prevailed during the months of January and February, necessitating several complete re-plantings of the whole of the rice section. Eventually a patchy germination coincided with the spilling over of the Rufiji river. The plots remained under approximately two feet of water for several weeks and thus once again the area proved a failure. Later rains enabled the planting of rain-grown cotton in the accepted normal period (March) and subsequent development was extremely good.

A distinction is made between rain-grown cotton and "Mlau," or floodland cotton. The prolonged flooding of the rice section afforded good conditions for the latter later on in the season; the two types are therefore mentioned separately:—

Rain-grown Cotton.—Thirty progeny plots of selections made in 1935 were, in view of adverse conditions prevailing in 1936, again planted, together with twenty progeny plot selections from the 1936 crop.

Excellent growth was made, influenced by the high water table caused by the flooded river, which incidentally rose to a height only six inches below that of the previous year's record level. Vegetative growth was excessive; widths of $9\frac{3}{4}$ inches measured transversely across the leaf laminae were frequently noted. Lint lengths were markedly superior to the strain in general cultivation and yields of over 1,000 lbs. per acre were obtained.

A striking malformation was noted where one of the plants in progeny plot 30, developed an extremely bushy scaffolding, in fact its appearance resembled that of a gooseberry bush. The leaves and flowers, although very numerous, were minute and although bolls were formed none were larger than normal peas, and without exception all were shed. The remaining plants in the plot were free from malformations, but showed a slightly more vegetative tendency than those of the other plots.

In 1935 a cross was made between U.4/4/2 and Egyptian, using U.4/4/2 as female. Three plants only were obtained in 1936, and from these, 76 plants from unselfed seed and 22 plants from selfed seed were produced this year. The plants from selfed seed have been picked separately and re-selections made. The dominance of the Egyptian is noted throughout, both in stature and habit, but bolls are generally small with a great diversity of types. The longer linted plants show crimping of the lint in the bolls but when the hairs are combed out this disappears. Segregation has brought to light many plants yielding brownish lint—an inheritance from the brown linted strains from which Sakel was originally evolved. Lint lengths of over $1\frac{1}{2}$ inches have been obtained and the strength is exceptional. The term Utian is being used to denote the hybrid. A back cross, using the Utian hybrid as female, and U.4/4/2 has been made. Further work on the hybrid will be continued next season when it is hoped to plant some of the seed under floodland conditions.

Floodland or "Mlau" Cotton.—In view of the observed similarity of conditions at Tokar in the Sudan, and the alluvial lands of the Rufiji delta, a small quantity of Tokar seed was planted at Mpanganya in 1936. The results were inconclusive, mainly owing to the extremely low germinative capacity of the seed. This year a large consignment of the new Tokar Egyptian seed was requisitioned from which good results have been noted. Although the Section B. (rice section), which had been well flooded, is not strictly typical of the alluvial lands of the Rufiji delta, nevertheless, as it was the nearest available approach to such conditions it was utilised for the purpose of the Tokar experiments. Two half-drill strips, using local cotton as control, and two bulk plots of Tokar were planted in May, *i.e.*, as soon as the water had receded and the surface cake had dried sufficiently to permit of planting. Planting holes some three inches in depth were made with stout poles as is the normally accepted local procedure in both Tokar and the Rufiji valley, and the seeds covered with a mixture of damp soil and sand. Excellent germination resulted and although during the first fortnight all the plants presented a rather etiolated appearance due to the water-logged nature of the soil, they quickly recovered as the land dried out and in spite of depredations by mole crickets, exceptionally fine stands were presented. A sharp colour differentiation was noticeable in the half-drill strips, the Egyptian being a lighter shade than the local control. As growth proceeded, the Tokar cotton inclined to a much more compact habit than the local and thus formed a much better ground cover; a vital factor for weed suppression on some types of alluvial soils.

The peak flowering period of the Tokar crop occurred approximately 14 days later than the control, but carried a much heavier crop of bolls. Unfortunately boll bursting coincided with a plague of field mice and despite all our efforts with traps and poisoned baits the experiments were completely spoiled. Cotton lay on the ground like snow between the rows and the staff was powerless to prevent the damage. The lint whilst lacking the lustre of the local upland cotton is much longer and much stronger.

The experiments were duplicated on a typical alluvial area further down the river, but owing to the slower rate of fall of the river and the low lying position of the plots planting was only possible much later on in the season. Reports indicate excellent results so far. Trials with Egyptian cotton are not new in Tanganyika but they have always proved abortive ; however, this year's experience gives reason for believing that further trials will indicate the success of Tokar seed in the alluvial lands of the Rufiji valley.

COTTON PESTS IN TANGANYIKA, 1937.

BY

W. V. HARRIS.

Insect damage to cotton in Tanganyika has been less than usual during 1937. The incidence of major pests has been in every case quite local. Meteorological conditions throughout the coastal belt were favourable for cotton, and with low populations of stainers and pink bollworm early in the year, good quality crops were obtained. Aphis and jassid were noticeably below normal. In the Lake Victoria area, cloudy weather, when sun was required for flowering, was responsible for a reduction of crop. Stainers were numerous at Shinyanga, and bulk plantings on the experimental farm were in consequence badly affected by internal boll disease.

Cricket was reported from Mpanganya, where they attacked the seedlings of the later planted flood-grown crop. They have been a pest in Bukoba, where plants of larger size were killed in the Kagera valley.

Field mice appeared early in the season at Kilosa, but an extensive poisoning campaign averted any serious infestation. At Mpanganya, field mice invaded the farm as the late flood-grown Egyptian cotton began to open and spoilt the experiment; the earlier maturing varieties escaped injury.

The extension of the areas infested by pink bollworm in neighbouring countries has led to a revision of the prohibited cotton zones in Tanganyika with a view to keeping out this pest from the Lake Victoria basin. The present favourable status of this pest in our coastal belt is due to the measures taken to ensure an effective close season. Propaganda is being continuously carried out among all sections of the community to this end.

Laboratory and field work on stainers has been continued. Work on *Helopeltis* has been abandoned owing to the absence of the insect. No new pests of any economic importance have appeared during the year.

NYASALAND
COTTON EXPERIMENT STATION, DOMIRA BAY,
PROGRESS REPORT FOR THE SEASON 1936-37.

BY

H. C. DUCKER, W. L. MILLER AND S. T. HOYLE.

SEASON.

The rainfall total for the season was 32.97 inches which is about the average for the Station. The total seasonal rainfall has not varied much since the Station was opened but the distribution has differed greatly from year to year. This distribution is probably the chief cause of variations of yield and, though it has never been so bad as to cause a complete crop failure, in not more than half the seasons can it be classed as "good." This year must be classed with the last two as "bad." In January there were 16 inches, nearly half of the above total, and only 1.5 inches in March. The result was that in the wet and sunless month of January growth was practically at a standstill, and in March there was not enough moisture for the crops fully to recover. The storm drains on the Station carried off much of the surplus water and mitigated the waterlogging in January. All except the flattest fields are ridge terraced and there was little erosion.

COTTON.

The strains of U.4 grown on the Station always make a good recovery after adverse conditions and, in spite of the uneven rainfall distribution, fair growth was made aided by some late rain in April.

It is possible that there would have been fairly good yields if it had not been for the very heavy attack of Red bollworm which is discussed below.

The cropping was exceedingly patchy and it was not uncommon to find small plots in a field yielding at the rate of 900 lbs. seed cotton per acre next to plots yielding 120 lbs. Part of this excessive unevenness can be ascribed to localised waterlogging and part to differential bollworm attack. But whatever the cause may have been, it meant, unfortunately, that little advance could be made in re-selection and not much reliance could be placed on the results of experiments.

A reserve of seed of all selections was kept, but in most cases there is enough seed harvested for planting next season, and this will be supplemented from the reserve.

Z.14 seemed to attract more than its fair share of bollworms and did not do nearly as well as C.28 this year. The selections from N.7 have shown a definite improvement, and this will be put into the strain trials in the coming season. G.5-79 from the Gatooma selections gave quite a good yield after looking as if its crop would be destroyed by jassid.

Of the other Gatooma cottons, G.5-122 and G.4-14 were quite fair, but the remainder were disappointing.

The best of the crosses was Harland's U.4×Cambodia backcross which gave excellent yields in places. The cottons with Gambia parentage, though of untidy habit, continue to show great cropping powers, though the lint still leaves much to be desired.

Cotton Experiments.—The cultivation experiment of last year was repeated, and the normal Station practice of light weeding gave a 25 per cent. increase over deep cultivation and the native practice of minimum weeding. The yields were very low, but they confirm last year's results.

The same result as last year was obtained with the spacing experiment, namely that 3'×2' leaving three plants per hole gave the best yield, but the difference between this and other spacings was not significant. A manurial trial in which ash from cotton trash and compost were used, gave no significant differences and the control actually gave a higher yield than either of the treatments.

PESTS.

The outstanding feature of last season was the unexampled severity of the Red bollworm attack on the fields of the Station. The graph showing the bollworm population of all instars collected at random over the fields, shows the extent and severity of the attack. The damage done was extensive, and though not general throughout the cotton-growing areas of the country, could easily be matched in many places. At the Cotton Station the main source of the attack was traced to moths breeding in an area of native cotton in the vicinity which was not uprooted at the end of last season. The yields of the fields at the side of the Station closest to the stand-over cotton were about 100 lbs. seed cotton per acre, and the fields at the other end of the Station yielded from 300 to 460 lbs. seed cotton per acre.

There are no known alternative hosts of Red bollworm in Nyasaland, and as far as we now know, the problem of control lies

BOLLWORM RECORD

DOMIRA BAY 1937

..... AMERICAN
—— RED

000'S PER ACRE

JULY

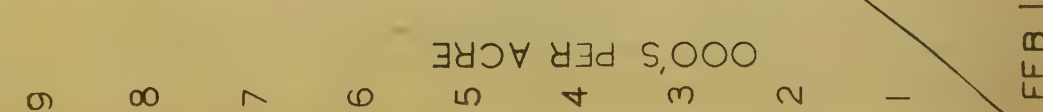
JUNE

MAY

APRIL

MARCH

FEB



in securing an effective close season, but this is not an easy matter in a country of peasant agriculture. In the first place there are isolated patches of cotton which may be up to two miles from the owner's village, and unless the owner wishes to disclose their whereabouts to visiting officials, they may easily go unnoticed. Even if all the gardens are located, there remains the problem of effective uprooting in such a way that the plants are killed and ratoon growth impossible. Early in September an area of native cotton was visited where the uprooting was supposed to be complete. Ten plots, each one-tenth of an acre, were measured and it was found that there were 398 holes not cut out, and 1,661 holes where the plants had been cut at surface level and regrowth was possible. At a spacing of $3' \times 2'$ this is 5 per cent. and 23 per cent. respectively.

In November the same area was visited again, and a similar area measured in gardens which had been "cleaned" for planting and another in gardens which were to be abandoned. In the cleaned gardens there were 60 holes where the cotton had sprouted and 170 per acre in the abandoned gardens.

On the Cotton Station the uprooting was done under close supervision, but there was still an appreciable amount of re-growth. Most of this was from lateral roots, but one instance was recorded where the cotton had sprouted from a tap root which had been cut 8 inches below the surface of the soil. A cotton plant puller was made locally similar to the one used in India (*Spotted Bollworms in S. Gujarat. Ind. Cent. Cotton Committee*). This instrument worked well and quite quickly, and in $2\frac{1}{2}$ acres uprooted in this way there were no cases of re-growth. Another $2\frac{1}{2}$ acres adjacent and treated similarly, but uprooted in the normal way, had 29 cases of re-growth. These figures are enough to show that without the willing co-operation of the cultivator it is not easy to secure proper uprooting.

American bollworm was present in the numbers shown on the graph, but was not important compared with the Red bollworm.

Stainers were again recorded on the lines devised by the Pest Control Section at Barberton, and observations made on their wild host plants. Stainers moved into the cotton in February, and remained below 1,000 per acre until the beginning of May when there was a rapid increase in the number of 5th instar nymphs and a less rapid increase in adults. By that time the bolls were fairly well advanced, and only the last of the crop received much damage from internal boll rot.

Two or three patches of cotton died out in the early part of the season and samples of the affected plants were sent to the Government Mycologist. *Macrophomania phaseoli* was identified on the specimens and observation will be made next season if there is any recurrence of the attack.

ROTATION CROPS.

The maize crop was affected by the early excess of rain and average yields of Potchefstroom Pearl were down to 2,100 lbs. per acre. On the other hand groundnuts did very well, and on ten acres there was an average of a ton of unshelled nuts per acre.

The maize time-of-planting experiment showed a progressive decrease in yield from the first planting at the break of the rains on 18th December. A week later showed little difference, but two weeks later showed a decline of 700 lbs. per acre. This has a bearing on the question of spacing out the maize planting to provide a longer period in which maize is attractive to the American bollworm moth. In the spacing experiment 3'×3' with one plant per hole yielded less than spacings with a higher number of plants per acre. Maize was planted on the site of last year's cotton manurial trial, but there was no residual response to the manures.

The native selected maize was tried against the Potchefstroom Pearl. There was a significant difference between the two, the native yielding 2,350 lbs. per acre, and the Potchefstroom 2,900 lbs. Further selections of the native maize have been made.

In the groundnut strain trial, the Barberton bunch was again better than the Station Virginia, Gambia and native varieties. A spacing of 18"×6" was better than 3'×6", but it is doubtful if the extra labour involved is worth the increase in yield obtained. The average yield for this experiment was 1,720 lbs. of shelled nuts per acre. In an experiment to test clean weeding against minimum cultivation, the former gave nearly twice the yield of the latter.

Sorghums did well, especially a short term variety from Swaziland, which gave a high yield and was most attractive in the field. Unfortunately this strain is very susceptible to weevil damage and it is difficult to store.

Of the beans grown, Bush Lima was a complete failure, but Green Gram did well yielding at the rate of 1,000 lbs. per acre. Soya beans were grown and the "Ami," Barberton Green and R.H.6 varieties did best, but there was difficulty in harvesting them.

CATTLE.

Last year the start of an experiment in keeping cattle on the Cotton Station was reported and at the time of writing they were doing well. At the break of the rains the Tsetse fly population increased largely, and in spite of regular injections of Antimosan (Bayer) or antimony tartrate, five of the bullocks died from trypanosomiasis. At the end of the wet season there were only four beasts surviving and these in rather poor condition. It was then clear that in order to keep cattle on an economic basis, a greater degree of protection from Tsetse fly must be afforded. On the east of the Station the land has been kept free from bush fires with the co-operation of the local native chiefs, and in a year or two, the thicket growth should be sufficiently dense to prevent the approach of fly on to the Station. The main reservoir of Tsetse fly is to the west of the Station and the clearing begun last year was further extended but still more clearing is needed.

It was decided to try whether the remaining oxen could last through the dry season without treatment and the last injection was given in May. Their condition improved considerably, and in July a start was made in working them. Between July and November they have ploughed or ridged 40 acres and done other jobs of harrowing and carting. This is a much better record than was expected at the beginning of the dry season, and it gives cause for hope that with further measures of protection from fly, cattle may be kept on the Station without undue losses.

In October it was found necessary to restart injections which resulted in an immediate improvement in the condition of the bullocks. Blood smears were taken at regular intervals throughout the year and sent to the District Veterinary Officer for examination. Trypanosomes were found regularly in two of the bullocks and less regularly in the other two, so it is certain that these have a good degree of tolerance to infection.

Compost was made throughout the year, but with only four animals the tonnage was necessarily small.

LILONGWE.

The Experiment Station at Lilongwe had a season somewhat similar to that at the Domira Bay Station, but the excess of rain at the beginning of the season was not so marked. The site of the cotton plots was a well drained one and the plants were not much affected by the heavy rains in January, but the lack of rain in March restricted the growth of the plants and in this season it would have

been advantageous to have used a closer spacing. The bolls opened well, but the final yields were not so good as last year. The strains of U.4 now grown on this Station are a great improvement on those of a few years ago, but they are not quite good enough to be considered a safe crop for the district.

The best strains in small bulk are two local selections, L.1 and L.33, and one from Gatooma, G.2-26, which all gave over 100 lbs. of lint per acre. Some of the other Gatooma strains were not far behind, but did not come up to the above yields.

Unfortunately, the best of the local selections have a rather short lint, and the best of the Gatooma cottons have a low ginning percentage ; a satisfactory combination of the two is being sought. Further selections have been taken in both lots.

Stainers were counted in the fields and observations made on wild host plants. In the field *D. fasciatus* reached 1,000 per acre in mid-March and 3,000 in mid-April, and remained at about that figure until the middle of May when the numbers began to decline. *D. intermedius* did not reach the 1,000 mark until the middle of April and then rose to 2,000 at the end of the month when they remained constant for three weeks and then fell off rapidly. The early crop was quite fairly free from staining, and there was not much late crop to be affected by the rise in stainer population.

NIGERIA.

PROGRESS REPORT FROM THE CORPORATION'S SEED FARM, DAUDAWA, 1936-37.

BY
G. BROWNE AND A. E. CASEMENT.

This report covers the period from November 1st, 1936 to the 31st October, 1937, and is written as usual about halfway through the season 1936-37.

CROPS.

Cotton.—The cotton crop last season was made up as follows :—Strain D.31—320 acres on the Main Farm, and approximately 40 acres on the settlers' farms ; Strain E.31—10 acres on the Main Farm ; Strain K.1—250 acres on the Main Farm, and approximately 155 acres on settlers' farms. Germination had been poor throughout the planting season and a dry period had held up planting and growth.

A rather open autumn helped things somewhat and as there was very little disease or insect damage, yields were not as poor as had been expected. Picking commenced on the 2nd January with the cotton quite clean and free from stainer damage. Three pickings were taken, the last being on the 12th March.

Some 73,373 lbs. of No. 1 grade seed cotton and 739 lbs. of No. 2 grade were obtained from the 580 acres on the Main Farm, giving an average yield per acre of 127.7 lbs. The highest maximum yield of any individual field was 225 lbs. as against 295 lbs. per acre in the previous season. The D.31 strain gave an average of 146 lbs. per acre, while the K.1 gave 148 lbs. and the E.31 154 lbs. per acre respectively. On the Co-operative Farms where only K.1 was planted, the total quantity of No. 1 seed cotton purchased was 21,399 lbs. and the highest individual yield per acre was 266 lbs.

The Mixed Farmers' seed cotton amounted to 6,121 lbs. of No. 1 and 138 lbs. No. 2 which was all D.31 and showed the highest individual yield as 179 lbs. per acre. The permanent experiment in which the current strain of cotton under multiplication is compared with the commercial seed in general distribution gave the yield of D.31 as 145 lbs. per acre as against 122 lbs. per acre for the standard commercial seed.

The price paid for No. 1 seed cotton throughout the season varied between 1·10d. and 1·20d. per lb.

At the request of the Government Botanist the D.31 strain was ginned at Funtua ginnery while the K.1 and E.31 strains were both ginned and pressed at the Daudawa ginnery as in the previous season. The 50,994 lbs. of D.31 seed cotton ginned at Funtua produced 18,128 lbs. of lint and 33,283 lbs. of seed, giving a ginning percentage of 35·55. The K.1 strain ginned at the farm ginnery, produced 13,805 lbs. of lint and 33,500 lbs. of seed from 47,050 lbs of seed cotton, a ginning percentage of 29·34. The E.31, which produced a total yield of 1,520 lbs. seed cotton, gave 520 lbs. of lint and 1,005 lbs. of seed, a ginning percentage of 34·2. From the experiment of standard commercial versus D.31 the 614 lbs. of commercial strain gave 192 lbs. of lint or 31·27%, while the 717 lbs. of D.31 gave 356 lbs. of lint, a ginning percentage of 35·7. The hand pickings obtained in cleaning the No. 1 grade cotton amounted to 877 lbs., which included 138 lbs. bought from the settlers. This produced 332 lbs. of lint or 37·85%.

The seed from the D.31 strain ginned at Funtua was retained there, while the seed from the K.1 ginned at Daudawa was not wanted for distribution and was used for cattle feeding purposes. The E.31 seed was retained on the farm to augment the supply of that strain sent by the Government Botanist to enable 20 acres to be planted.

The D.31 lint from Funtua was made into 46 full bales and sent home from Funtua while the remainder which was ginned on the farm was made into 100 half-pressed bales and sent home direct. The Brokers reported the D.31 from Funtua as Strict Good Middling, good colour. Staple $1\frac{1}{8}$ ", strong, value 7·85d.; the K.1 as Strict Good Middling, creamy colour. Staple about 1", soft, value 7·60d., the E.31 as Strict Good Middling, creamy colour. Staple $1\frac{1}{8}$ "— $1\frac{1}{8}$ ", rather irregular, value 7·75d. Based on May American Futures at 7·05d.

Before commencing the report of the work done during the first part of the present season, it should be mentioned that an important decision with regard to the cropping policy for the farm was made prior to planting. In brief it is a scheme whereby crops are restricted to the requirements of the following year. For instance, the Agricultural Department notify the amount of cotton seed they require for the following season, and a sufficient number of acres of cotton are planted to provide that quantity of seed. Again, a system of animal food rations is being worked to, and the approximate number of cattle to be kept the following year being known, it is easy to calculate roughly how many acres of cereals etc. are required to feed both them and the farm labour. The remainder of the farm not required for these

and other crops is laid down to grass. In addition, certain large-scale cropping experiments can be carried out.

The reasons for the change-over are as follows : (1) Improvement of average yields ; (2) Improvement of the general condition of the farm, through grass fallowing and manuring ; (3) Saving of labour through not having to work land for unnecessary crops.

Naturally the best fields are selected for cropping and the worst ones (which in the past have reduced average yields) will be laid down to a grass fallow with manure. The latter will, in two or three years, be once more capable of first class crop production. In the meantime, these grass fields will serve as pastures for the herd and will at the same time be naturally manured and enriched thereby; they will also produce any quantity of haygrass and bedding etc. as required.

Planting was commenced this season on the 28th June and with the aid of exceptionally good weather conditions was completed on the 22nd July. With an ample seed rate and good germination, quite a good stand was obtained from the beginning, and very little supplying was necessary. With the exception of 20 acres of E.31 and 10 acres for the permanent experiment, D.31 is being grown over the whole of the Main Farm and on the Mixed Farmers' and Co-operative Farms. August and September were both very good growing months and the cotton came on very well. However, the rains finished with the end of September and what might have been a very good year has been rather spoiled by the lack of October rains. Some aphid damage and leaf curl are now becoming evident together with the usual amount of bollworm damage, but on the whole at the time of writing (October 31st) the crop looks very well and yields should be well above average.

Intensive cultivation has been carried on again this season with beneficial results. The new small breasts as now fitted to the "Emcot" plough for ridging between the rows of small plants have played a very useful part in the work. A certain amount of flowering was noticed in late August and September but the bulk of the flowering as seen in October looked very promising.

Bullrush Millet.—The 100 acres of millet grown last season, and for which no yields were available at the time of the report, when threshed yielded 8,401 lbs. of grain or 84 lbs. per acre.

This season it was decided to dispense with the crop altogether, but a 2 lb. sample of Gold Coast, early maturing, seed was sent by the Government Botanist, and this sample was planted. The rains this year at millet planting time were very unreliable with the result that very poor germination was obtained. However, the corn harvested from this is being kept for seed for next season when it will be given

another trial. The main advantage attributed to this variety is its short growing period which should enable it to be harvested as a catch-crop before the planting of the cotton begins.

Guinea-corn.—The total area under guinea-corn last season was 215 acres and this yielded a total of 69,546 lbs. of threshed grain, an average of 323 lbs. per acre. The 60 acres of this which were grown among millet and groundnuts yielded 251 lbs. per acre ; the 40 acres grown with millet alone gave 213 lbs. per acre ; the 55 acres grown through groundnuts gave 344 lbs. per acre, and the remaining 60 acres grown as a straight crop close spaced, 467 lbs. per acre.

This year guinea-corn is only being grown as a straight crop, closely spaced, on 130 acres. The early rains were very uncertain and the first planting was a complete failure. However, it was all re-sown on newly made ridges after the dry spell had broken and got established quite well. Some locust hoppers that approached the farm unobserved gained access to one field and did a very considerable amount of damage, and, the season being so far advanced, it was impossible to obtain a good stand again although the worst parts were transplanted with the thinnings from the other fields. The remainder of the crop looks very well and gives promise of good yields.

Groundnuts.—Last year's groundnut crop was in no case taken as a straight crop but was either grown through millet and guinea-corn or through guinea-corn alone. The 115 acres sown produced 25,633 lbs. of unshelled nuts, an average of 223 lbs. per acre. The bulk of the nuts when shelled, some 15,120 lbs., were sold at £9 per ton, and the remainder was kept for seed. This year the only groundnuts that are being grown are those planted as a cover crop in the orchard at the residential site.

Sweet Potatoes.—At first it was decided to plant 20 acres of this crop to be used for cattle feeding, but owing to the difficulty experienced in obtaining seed, it was only found possible to plant 10 acres this season. The other 10 acres have been planted in native beans which can also be used for stock feeding. Both these crops look quite promising.

Mucuna Beans.—These beans are also being grown on 20 acres this year for feeding purposes. Owing to the fact that only the seed retained on the farm from the 1933-34 crop was available for planting, the stand is very irregular.

Pigeon Peas.—As an experiment to test the value of pigeon peas as pan breakers, this crop is being grown in 1-acre strips through a 20-acre field with cotton in alternate strips. Next season cotton will be grown over the whole field and the relative yields of the various

strips recorded. It is intended to use the peas for stock feeding. Quite a good stand has been obtained at 3 ft. spacings and the crop looks well.

English Potatoes.—A small quantity of potatoes were tried as an experiment last season. They were planted in late September, but owing to the lack of water for irrigation were more or less a failure. They have been tried again this year; the first planting in May has been harvested and yields are quite fair, but it is feared that owing to the early finish of the rains the second crop planted at the beginning of October will not be very successful.

Haygrass.—This season as explained above 200 acres consisting of the poorest fields on the Main Farm have been allowed to revert to grass. This grass has been used for grazing and is also being cut with the mower to be used for fodder and bedding. Another 35 acres in the Mixed Farmers' extension area have also been left under grass.

CROPPING SCHEME.

The following is a summary of the cropping scheme for 1937-38.

Total area of Main Farm	...	...	...	...	900 acres
Land occupied by Mixed Farmers	...	...	...	...	105 "
„ left for Mixed Farmers Extension (grass)	...	...	...	...	35 "
Area under Cotton	...	...	...	...	379 acres
„ „ Guinea-corn	...	...	...	...	130 "
„ „ Mucuna Beans	...	...	...	...	20 "
„ „ Native Beans	...	...	...	...	10 "
„ „ Pigeon Peas	...	...	...	...	11 "
„ „ Sweet Potatoes	...	...	...	...	10 "
„ „ Grass	...	...	...	...	200 "

CATTLE.

The herd now consists of 182 head, made up as follows:—118 male working beasts, 21 cows and heifers over three years old and 43 young stock including calves. There are 5 heifers born on the farm which have now calved down and 2 young bulls that have been transferred to the working stock. The deaths for the season total 9, 5 from sclerosis of the liver, 1 from trypanosomiasis, 1 from horn gore, 1 from tuberculosis and 1 calf from inflammation of the intestines. Another 11 beasts were also rejected from the herd. These were either barren heifers or beasts that would not work or were too old to be of further use, and were either killed on the farm and sold as beef, or sold to traders. There were also 10 working beasts taken from the herd to supply the settlers and Co-operative Farmers. The cattle have kept remarkably healthy

and there have been no outbreaks of infectious disease.

Cattle have become still more difficult to buy and prices continue to rise. Some 340 acres received a dressing of farmyard manure prior to the planting season.

LABOUR.

There have been ample supplies of male labour throughout the year but women and children have also been employed for the planting season. An outbreak of Dengue fever occurred in the labour camp during the busy season and caused considerable inconvenience, but luckily the infection was mild and there were no casualties.

SETTLERS' FARMS.

Another three men have taken over mixed farming holdings on the main farm and two of the original co-operative farmers have bought cattle and ploughs and have also taken up cattle cultivation. This gives us a total of 15 mixed farmers, nine of whom have settled on the main farm and six who were Co-operative Farmers under the original scheme, but who have since adopted cattle cultivation. All these men are doing good work, keeping their farms in good order and tending their cattle well. One of the original settlers on the main farm has been granted his 5-acres extension, the necessary condition before this is done being that he farms his present holding well, and gets the maximum amount of manure on to his land. This man now holds 15 acres.

Crops on the whole are quite good, although, owing to the uncertainty of the early rains, some of their corn is a little disappointing. There is an estimated total area of 211 acres under cotton among the farmers this year, this figure including those co-operative farmers who have not yet taken up cattle.

The difficulty experienced in purchasing suitable working oxen this year, together with the high prices asked, has held up the spread of animal husbandry among the co-operative farmers, and, as the beasts had to be supplied from the herd, no others could be started this season without seriously depleting the number of working animals needed for the satisfactory working of the main farm.

WATER-WORKS.

Owing to the fact that the existing caisson at the pump house was not sufficiently large to supply the dry season demands for water on the farm, another of slightly larger bore was sunk this year to be used in conjunction with the old one. The demand for water for the stock

and ginnery is now so high that even the united capacity of these two caissons is still unable to meet the requirements.

Another two wells have been sunk and lined with concrete and are both quite satisfactory.

BUILDINGS.

A new cattle-pen was commenced in the early part of the year but the destruction of No. 2 staff house by fire has interfered with the work, as the masons had to be brought at once to commence repairs. This house has now been completely renovated and No. 1 staff house is being improved and repaired.

LOCUSTS.

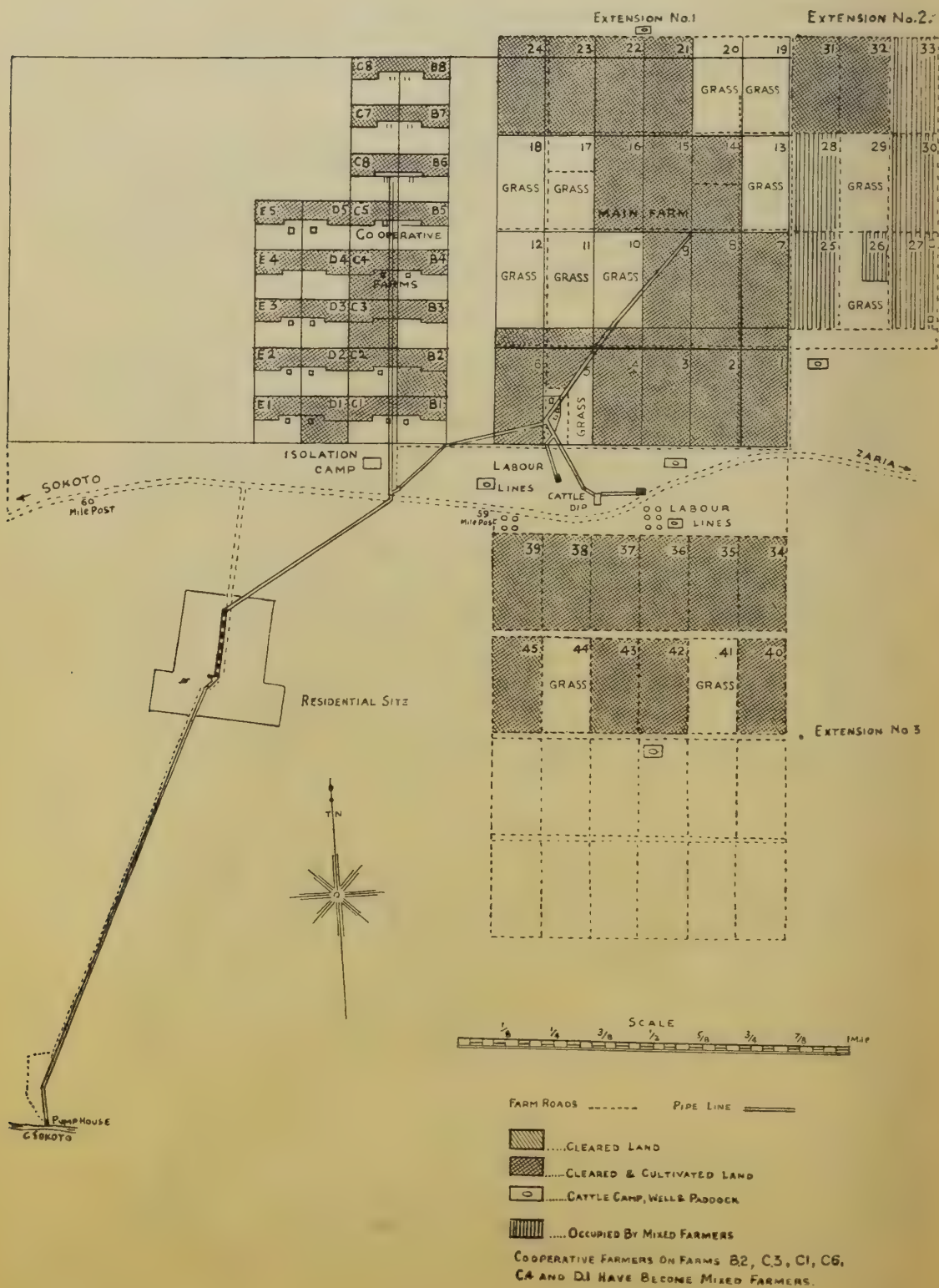
Hoppers invaded the farm in November of last year but no damage was done. A swarm of night-flying or tree locusts made their appearance in March and did quite an amount of damage to the citrus trees in the orchard. In July a swarm of hoppers gained entrance into a field of guinea-corn unnoticed and did considerable damage to the young corn.

METEOROLOGICAL DATA.

A storm occurred in December of last year but did no damage to the cotton as very few bolls had begun to open. This year the planting rains were very late, and after they had started were very unreliable, with the result that the corn crops had to be re-sown in some cases twice before they finally established themselves. After this the months of July, August and September were particularly good for growth, but unfortunately the rains finished with September.

GENERAL.

This opportunity is again taken to extend thanks to the Administrative, Agricultural, Veterinary and Medical Departments for their constant assistance and co-operation throughout the year.



[Included by courtesy of the Nigerian Government.]

NIGERIA.

PROGRESS REPORT ON WORK ON COTTON IN THE NORTHERN PROVINCES FOR THE SEASON, 1936-37.

Growing conditions and yields were fairly normal at Zaria during the season under review though planting was delayed a week by lack of rain in early July.

The three strains described at length in the last report were tested again at Zaria with practically the same results. D.31 was grown on 300 acres of the Empire Cotton Growing Corporation's farm at Daudawa, ginned at the British Cotton Growing Association's air-blast gin at Funtua and 46 bales sent to Lancashire, arrangements having been made for them to be distributed among a number of mills likely to be interested in this class of cotton. Its characteristics determined at the Shirley Institute over the past two years are as follows :—

			<i>Lea Strength</i>		<i>Hair Wt.</i>	<i>Immaturity</i>		<i>Mean</i>
			<i>at 40's.</i>	<i>at 32's</i>	<i>per cm.</i>	<i>% Normal Hairs</i>	<i>% Dead Hairs</i>	<i>Length mm.</i>
1935	...	...	45	—	177	50	15	19.9
1936	...	...	43.7	60.7	178	43	14	21.4

No reports have yet been received from the mills and seed of this strain is accordingly being stored for the present.

D.31 was tested at six stations in different parts of the country in 1936-37 with the following results :—

<i>Station.</i>	<i>Yield of Standard</i>	<i>Differences of D.31</i>	<i>Yield of D.31 Seed Cotton as % of standard</i>	<i>Calculated yield * of D.31 Lint as % of standard</i>
	<i>lbs. seed cotton per acre</i>			
Zonkwa	338	+ 116 ± 18	134	151
Zaria	264	+ 86 ± 16	133	149
Malumfashi	283	+ 76 ± 23	127	142
Kano	157	- 106 ± 19	167	189
Gusau	116	- 13.7 ± 13.9	88	102
Kafinsoli	101	- 1 ± 9	100	110

* Assuming Ginning % of Standard is 31.5
D.31 35.5
based on Funtua ginning figures.

Zonkwa, in the south-east corner of Zaria Province, is about 200 miles South of Kafinsoli and has the highest rainfall. The cotton plots at Kafinsoli and Gusau are liable to waterlogging, and it is only

in years of unusually well distributed rainfall that good yields of cotton are obtained at those stations.

Nine selections from D.31 were tested against standard on a small scale. A summary of the results is as follows :—

Variety	Yield of lint as % of Standard	Immaturity		Mean Hair wt. per cm.	Standard Hair wt. per cm.	Count × Strength Product at 32's
		% Normal Hairs	% Dead Hairs			
8	152	46	12	189	217	2,147
2	151	54	8	188	202	1,900
3	143	57	8	190	205	1,907
10	137	48	13	190	217	1,903
9	135	45	11	182	209	1,986
1	134	60	4	198	202	1,902
5	128	46	14	192	223	2,289
7	117	41	11	173	204	2,203
4	117	54	12	174	191	2,100
Standard	100	42	16	166	200	2,319

Standard Yielded 130 lbs. lint per acre.

Standard has the lowest yield, the worst figures for immaturity and the best count×strength product. No. 5 is interesting in that its count×strength product is second only to standard though its hair wt. per cm. is high. All the yarns were classified as fair in appearance though it might have been expected that No. 1 would have been better in this respect than standard.

This trial was sown through Gero spaced at 6 ft.×3 ft. which yielded 547 lbs. of grain per acre. The cotton was spaced at 3 ft.×1½ ft. and the two crops were on the land together for about a month. Farmyard manure was applied at the rate of 1½ tons per acre before the Gero.

Another variety trial on a still smaller scale gave the following results :—

Number	Origin	Yield of lint as % of Standard
J	D.31	176
C	D.31	168
D	D.31	157
A	E.31	145
E	U.4.4 from South Africa	115
F	U.4.2. from South Africa	104
B	A.F.D.46 Trinidad hybrid	103
G	A.F.D. Trinidad hybrid	101
H	S.G. 27 Uganda Selection	100
Standard...	Allen	100

Standard yielded 200 lbs. lint per acre.

The cotton was planted alone 1 ft. apart on 4 ft. ridges, and farmyard manure was applied at the rate of two tons per acre. None of the exotic varieties was significantly better than Standard, but the Spinning Test Report had not been received when this report was written.

INTRODUCTIONS.

Seed of S.P.86 and S.P.87 was introduced from Uganda at the end of the season and these strains are now under trial.

PROGRESS REPORT ON COTTON SELECTION WORK IN THE SOUTHERN PROVINCES, SEASON 1936-1937.

BY

E. H. G. SMITH.

GENERAL.

For the second time in recent years, the incidence of rainfall overshadowed cotton selection at Ibadan. But in contrast to 1934, which was an excessively wet year, the trouble in 1936 was due to drought after planting. The cotton season at Ibadan extends from about the beginning of July until about the middle of March, and the rainfall from July to October may determine the comparative success or failure of the crop. The rainfall for these four critical months in 1936, with the monthly averages of previous years, is appended :—

MONTHLY RAINFALL IN INCHES

				<i>Average</i>	
				1910-1935	1936
July	...	...	...	6.55	0.49
August	...	...	...	3.35	0.37
September	...	...	...	6.96	5.52
October	...	...	...	6.56	4.90
Total July to October				<u>23.42 ins.</u>	<u>11.28 ins.</u>

The total shortfall of rain, compared with the previous average over the period included, is seen to be rather more than fifty per cent. The rainfall of July, usually one of the wetter months, was remarkable, though it is of interest to observe that since 1910, when records begin, several rather dry Julys have been recorded. Of these, however, only July 1922 was quite as severe, and never before has the combined July and August rainfall been so low. For this reason it is important to sow cotton as early in July as possible at Ibadan, though in a wet year this does not always pay, as the 1934-35 cotton season illustrated. In 1936, the selection plot was sown on July 1st, after a little rain the previous night. Thereafter, no rainfall was recorded until August 26th, a period of nearly two months. As a result of the dry conditions, germination was very poor, and growth was greatly retarded. In the end, a fairly good stand was obtained, but many plants were backward, and never recovered from that condition.

The growing conditions described gave some advantage to those strains which germinated most freely, or of which sufficient seed was available for a generous first sowing. With some exceptions, the general size of plant was below average, hence yields were low. In addition, flowering was late and boll shedding was heavy.

The prolonged drought gave an interesting sidelight on how

cultural treatment may affect crop development in an unusual season. It is the common practice to prepare land for cotton some two or three weeks before the crop is to be sown. In 1936, some late prepared plots gave a better germination than was obtained with those prepared at the normal time, probably because of the absence of a surface pan due to lack of rain.

Ishan Strain A.—The routine re-selection with improved *Ishan A* proceeded. The measurable characters of the selected single plants, and the strain averages, together with the data for previous seasons, are appended:—

(I) SELECTED PLANTS.

Measurable Characters	1936-37		1935-36		1934-35		1933-34
	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	
Halo length (mm.) ...	32.2	33.3	31.25	31.3	34.3	32.2	29.5
Ginning percentage ...	34.8	35.1	35.9	36.5	34.4	35.6	37.0
Number of bolls ...	108	123	214	191	83	61	102
Weight of seed cotton (grms.) ...	164	189	462	361	82	75	217
Weight of seed cotton per boll (grms.) ...	1.51	1.53	2.16	1.89	0.99	1.23	2.13

(II) AVERAGE OF ALL PLANTS EXAMINED.

Measurable Characters	1936-37	1935-36	1934-35	1933-34
Halo length ...	32.9	30.16	30.9	29.7
Ginning percentage ...	34.5	35.8	33.6	36.6
Number of bolls per plant ...	48.0	112.0	44.0	58.4
Weight of seed cotton (grms.) ...	66.0	207.0	46.0	98.2
Weight of seed cotton per boll (grms.) ...	1.32	1.74	1.04	1.7
Node of first fruiting branch ...	14.1	15.0	15.0	14.9

These figures suggest that recently there has been a cycle of poor cotton seasons. That of 1934-35 appears to have been the worst, followed by 1936-37, while 1933-34 was rather below normal.

First Ishan A × Sea Island Backcrosses.—These cottons are produced by the crossing formula (*Ishan A* × *Sea Island*) × *Ishan A*, and 33 single plant lots were grown. Unfortunately, the first backcrosses suffered most severely from the field conditions that prevailed in 1936-37, and most plants were small in size. On account of the indifferent growth, which reduced yields, no proper selections could be made, and no real progress was achieved in 1936-37 with the first backcrosses. It is becoming apparent, however, that no first backcross strain is ever likely to be suited on vegetative characters to Southern Nigerian conditions. It seems that such cottons can only serve as material for the production of second backcrosses, and that it is from among the latter that new strains must be sought.

Second Ishan A × Sea Island Backcrosses.—What are termed the second backcrosses are produced by backcrossing to *Ishan A* the

hybrids described in the last paragraph. In contrast to the first backcrosses, the second backcrosses did reasonably well in 1936-37. Selections were made for next season which, on vegetative and lint characters, appear to show some promise. In addition, further second backcrosses were made for single plant selection in 1937-38.

In conclusion, it should be added that a number of first backcrosses from St. Vincent arrived too late for sowing during the season under review. The seed was kept in desiccators, and these cottons are under trial during the present (1937-38) season.

WEST INDIES.

COTTON EXPERIMENT STATION, ST. VINCENT, PROGRESS REPORT FOR THE SEASON 1936-37.

BY

S. H. EVELYN.

GENERAL.

The cotton season opened on the 1st August, 1936, and there was a substantial increase in the acreage planted in the island. The total area grown was 5,294 acres of which 3,139 acres were grown by peasants. The amount of lint produced was 417,769 lb. (1,044 bales) of which 13.6 per cent. were stained. The average yield was 79 lb. of lint per acre.

The poor yield can be attributed to three causes (a) the very unfavourable season experienced, (b) the acreage increase—which included some land most unsuitable for cotton and (c) the increase in damage from pink bollworm.

Throughout the season the rainfall distribution was adverse. Spells of drought and heavy rains alternated during the whole length of the vegetative period of the crop. In January, when dry weather was required for the ripening and bursting of the bolls, rain was recorded on 28 days of the month, and, as a result, there was a very high incidence of boll rot (*Phytophthora* spp.). There was also a high incidence of Blackarm disease.

The damage resulting from pink bollworm was the greatest since 1929, and it is considered that the earlier planting season had much to do with this. Pink bollworm has been a negligible pest since 1929 when the sowing date was changed from June-August to the 1st September.

A small isolated attack of cotton leaf worm was experienced this season—the first since 1929.

Except in a few isolated instances cotton stainers were very scarce.

At the Station, the adverse weather conditions caused a heavy loss in the self-fertilized material. It is, however, pleasing to note that

sufficient selfed seed has been obtained from all the strains to allow of the experiments being carried on without interruption.

PLANT BREEDING EXPERIMENTS.

Standard V.135.—Fifteen strains, selected for high lint index and high ginning outturn, were grown this season in progeny rows. The results of the analysis of these showed an improvement on past strains. Owing to unfavourable weather conditions and damage from pink bollworm the loss of bolls in this experiment was estimated at 70 per cent. Twelve excellent selections have, however, been obtained with high lint indexes (4.7 gm. to 5.1 gm.) and high ginning outturns (25.5 per cent. to 28.2 per cent.).

In continuation of the practice of multiplying pure line V.135 seed at the Station, $1\frac{1}{2}$ acres were grown which yielded 683 lbs. of selfed seed. This seed will be grown at Diamond Estate next season to form the Island's 1938-39 seed supply. The multiplication area of 70 acres at Diamond Estate suffered badly from the adverse climatic conditions and it was therefore necessary to examine and select other cotton areas to supplement the seed supply for the 1937-38 season. An estimated amount of over 70,000 lbs. of seed is available for next season's commercial crop.

In spite of unfavourable weather conditions valuable information on the relative merits of Montserrat and V.135 cotton was obtained from the Agricultural Department's manurial and variety trials. By permission of the Superintendent of Agriculture data for the varietal comparison are given below (in lbs. per acre).

		Mean Yield.		Coefficient of Variation.	P (diff.).
		V.135.	Montserrat.		
Cane Garden	Seed cotton	675	671	5.0	0.8
	Lint	174	227	5.6	0.01
	White (unstained) lint ...	137	154	5.8	0.1
	Ginning per cent. ...	26.6	34.5	3.3	v. small
Camden Park	Seed cotton	745	622	4.7	0.02
	Lint	178	201	5.0	0.07
	White (unstained) lint ...	149	172	5.3	0.06
	Ginning per cent. ...	24.5	33.2	3.9	v. small

At Cane Garden, Montserrat and V.135 gave practically the same yield of seed cotton, while at Camden Park, which is wetter and more typical of St. Vincent conditions, V.135 outyielded Montserrat by a significant amount. At both places the ginning percentage of Montserrat was significantly better than that of V.135, and consequently in lint yield Montserrat exceeded V.135 by a significant amount at Cane Garden, and by an amount approaching significance at Camden Park. The actual excess of Montserrat over V.135 was just over 12 per cent.

Field observations showed that Montserrat suffered considerably more from external boll disease than V.135. The yield of white (unstained) lint was therefore analysed. The yields of white lint were higher from Montserrat at both places, but at neither place was the difference significant.

At Cane Garden significant increments in yields were obtained from the application of nitrogen or phosphate and a further increment (significant interaction) by the application of the two together. At Camden Park, the application of nitrogen gave a considerable, but not significant, increment. Phosphate had no appreciable effect, but the interaction of nitrogen and phosphate depressed yield significantly. Potash had no effect at Cane Garden, but gave a significant increment at Camden Park.

At Camden Park, where V.135 gave a significantly higher yield of seed cotton than Montserrat, there was no significant interaction between variety and manuring, but at Cane Garden, where the mean yields of seed cotton were almost equal, the interaction between variety and manuring was highly significant. The response of V.135 was greater than that of Montserrat to each manure.

The relationship between environment and varietal behaviour is evidently complex, and will only be elucidated by careful experimentation over a series of years. If, however, the premium for superfine quality is small, the higher ginning percentage of the Montserrat strain will turn the scales in its favour.

Standard errors were low for all determinations, showing that in spite of the unfavourable season the data provide a good estimate of the relative behaviour of the two strains under such conditions.

Red Sea Island.—Forty Red Sea Island selections were grown which, although as badly affected by the adverse season as the V.135 progeny, produced many very promising strains. Selection was based on the weight of lint and seed cotton per boll and lint index, as these strains, although showing improvement, do not produce as many bolls per tree as V.135. Owing to a shortage of material, lint samples could not be obtained for spinning tests. Selections for next season range in lint index from 5.4 gm. to 6.5 gm. and in ginning outturn from 26.5 per cent. to 31.3 per cent. (*cf.* V.135 selections). As stated in previous reports these strains are all now pure for superfine staple length and red plant body.

The V.135 × Montserrat Sea Island Hybrids. — Strains with superfine, intermediate and short staple lengths were grown this season. The growth of the 62 strains was, in general, poor and the bad weather conditions must have seriously affected the yield results.

The analytical results did not come up to expectation and a high lint length variation was a marked feature of almost every strain. The heavy loss of selfed bolls prevented many strains from being completely analysed. Notwithstanding this, thirty-seven strains are being carried forward next season—23 with superfine length of staple, 7 of intermediate length of staple and 7 with short staples. Spinning test samples could not be obtained.

The Asiatic × U.4 Strains. — Forty-three Asiatic × U.4 strains were tested this season against standard U.4. To obtain greater uniformity the strains were sown in pots and then transplanted to the field. Reports from Stations to which this material has been sent at various times indicate that it is lack of hairiness which causes it to fail when attacked by jassid. Accordingly selection this season was based primarily on the factors hairiness and early maturity. The strains grew well and some were remarkable for their earliness. Counted from the date of sowing, flowering occurred as early as 45 days, boll-splitting as early as 83 days and harvesting of the complete crop from individual plants as early as 105 days. One plant took only 35 days between flowering and boll-splitting.

Intercrossing between the best strains was practised this season and many of the best strains were also crossed with standard U.4.

Thirty-one strains will be carried forward next season. It is reported from Nyasaland that one strain, R.U.4.43-19-6, has shown great promise in that area.

GENETIC EXPERIMENTS.

This section of the Station's work is now being reorganised and as conclusive results are not yet available from the experiments in hand it is considered that a discussion of the results so far obtained would be valueless at this stage.

The following is a list of the experiments that are being undertaken :—

- (1) The relation between corolla colour, corolla spot and leaf callus spot in the Sea Island strains AN, BD, and Sea Island White.
- (2) An investigation into the behaviour of a semi-sterile mutant of V.135.
- (3) A study of the character Boll Loculus Number in Sea Island strains.
- (4) A study of a "Fuzzed" type of V.135.
- (5) An investigation into the character "Kidney" seeds.

- (6) A study of aborted ovules in Sea Island strains.
- (7) Interspecific Hybrids.

THE COTTON TYPE COLLECTION.

Over two hundred cotton types were maintained this season in pure culture.

MISCELLANEOUS.

Assistance was given this season to the Cotton Research Station, Trinidad, in an investigation to determine the effect of boll position on hair characters. This work will be continued next season.

(Included by courtesy of the Fiji Government.)

FIJI

COTTON EXPERIMENT STATION, SIGATOKA, PROGRESS REPORT FOR THE SEASON 1936-7.

BY

D. A. DONALD.

SEASON.

The season commencing October 1936 was very satisfactory. Precipitation was adequate and well distributed, and no severe storms or floods were experienced. Although the total rainfall for the period under review was only a little above the average, the number of wet days was considerably greater, and this interfered somewhat with cotton picking.

BREEDING AND SELECTION WORK.

Backcross 172.—Of the 23 selections from the previous season three have been retained for trial in increase plots. The yield of each of these three on an acre basis averaged over 1,000 lbs. seed cotton, while retaining the characteristics of the type 172. Fifty single-plant selections were made. Twenty-five have been discarded in the laboratory and the remainder will be planted in progeny rows next season. Selection has been based on obtaining uniformity in lint and plant type, with increased yield.

Second Backcrosses.—The four strains selected in the previous season for trial during this season have proved disappointing and it is proposed to discontinue further work with double backcrosses.

CULTURAL.

Spacing Trial with Backcross 172.—This trial is a repetition of last season's. Randomised blocks of $\frac{1}{5}$ acre each on a Latin square layout containing four series of four spacings gave the following results :—

Yield of seed cotton per acre.

	1935-36	1936-37
3 × 3 ft. ...	1,087.50 lbs.	881.25 lbs.
5 × 3 ft. ...	811.78 "	542.50 "
5 × 4 ft. ...	644.89 "	345.00 "
6 × 4 ft. ...	718.08 "	400.00 "
Probable error	± 129.95 "	± 140.99 "
P.E. per cent.	15.93%	13%

For the second successive season the closer spacing plots gave a significantly greater yield. Unfortunately it was not possible to make the final picking owing to acute shortage of labour otherwise the yields per acre would have been at least equal to those of the previous season. This experiment will be repeated this year.

PESTS AND DISEASES.

This season cotton was particularly free from pests and diseases.

Blackarm appeared only on the double backcrosses, and jassid also. The unusual freedom of the crops on the station may be partly ascribed to the moderate season, but is largely due to the fact that all crops were planted between early October and December. Stainers appeared only on the final pickings and then in very small numbers.

HARVESTING METHODS.

Seed cotton is bought at the Government ginnery on the basis of "White" and "Stained" classes only. An attempt was made therefore to eliminate the laborious and costly process of picking over and grading seed cotton after harvesting and prior to sale to the ginnery. The pickers were issued with two shoulder bags of cloth and instructed to pick all "white" seed cotton into one bag and all "stained" into the other. For the first three pickings results were very satisfactory and the seed cotton was received at the ginnery as picked without complaint. After the third picking, the proportion of "stained" cotton was too great for this method to be economic and it was picked over as formerly. The saving in cost of handling was considerable and no appreciable slowing up in rate of picking was noticed.

PROGRAMME FOR 1937-38.

The spacing trial with Backcross cotton 172 will be repeated for the third consecutive season. Three selections from the 1935-36 single-plant selections will be grown in increase plots of not less than one acre each.

The 1936-37 single-plant selections will be set out in progeny rows. The double backcrosses will be discarded. A de-flowering experiment will be conducted with the Backcross Cotton 172 on plots of $\frac{1}{5}$ acre, as suggested by Singh and Choudhri (E.C.G.C. Review, Vol. XIV, No. 2.)

A mixed cropping experiment with Backcross cotton 172 and quick maturing legumes, soya bean, cowpea, groundnut and mungh will be conducted on a Latin square layout.

It is proposed also to take some Sea Island cotton under observation again, none having been grown at the Station for the past four years.

Some seed of the original selection, S 17, made by Mr. R. R. Anson, is available and will be compared with the present Sea Island seed that is being issued by the Government ginnery at Lautoka.

CONCLUSION.

The unit ginnery system inaugurated by the Director of Agriculture is progressing satisfactorily. For the most part individual areas are smaller, but the aggregate area is increasing steadily. The area planted in 1936-37 was approximately double that of 1935-36, and there are indications that at least fifty per cent. more land will be planted in 1937-38. The average area planted to cotton by Indian cultivators is about one acre, while that of Fijians is not more than half an acre. The number of Fijians who planted cotton last season was four times that of the previous season.

To enable the grower to pick all his crop thoroughly and to increase thereby his returns per acre the principle of reducing the individual areas has been encouraged by the Department of Agriculture. That the principle is sound is evidenced by the increasing aggregate area under cotton and the increasing number of individuals engaged in its cultivation.

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- "Cotton Growing in Nigeria." Sir Hector Duff. Price 2s.
- "The Extension of Cotton Cultivation in Tanganyika Territory." Major Hastings Horne. 1922. Price 2s.
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- "A Cotton Research Station for the British Empire." Professor J. B. Farmer and Mr. L. G. Killby. 1925. Price 2s.
- "Report on the Cotton-Growing Industry in Uganda, Kenya, and the Mwanza District of Tanganyika." Col. C. N. French. 1925. Price 1s. 3d.
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- "Report on the Cotton-Growing Industry of Nigeria, 1926." Col. C. N. French. 1926. Price 2s.
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- "Review of the Situation in the Principal Cotton-Growing Territories of the Empire, and a Summary of the Main Activities of the Corporation since their Formation." 1928. Price 9d.

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List of Publications—continued.

- “ Report on Cotton Breeding and Seed Supply in Nigeria, 1928.” F. L. Engledow and C. N. French. Price **2s.**
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